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ABSTRACT

This Occupational Competency Analysis Profile (OCAP) contains a competency list verified by expert workers and developed through a modified DACUM (Developing a Curriculum) involving business, industry, labor, and community agency representatives from Ohio. This OCAP identifies the occupational, academic, and employability skills (competencies) needed to enter environmental management occupations. These 15 units are included: general safety and health; worker health and safety; environmental industrial technology; pollution prevention and assessment; environmental ecology basics; population growth and regulation; land management and usage; surveying and drafting; groundwater geology; investigation of environmental concerns; management of biological resources and environmental quality; land reclamation; environmental laws and regulations; practical application of environmental regulatory requirements; and business management. The units detail the knowledge, skills, and attitudes (competency builders) needed to perform each competency. Within the competency list are two levels of items, core items essential for entry-level employment, and items needed to advance in environmental management. The OCAP guide also contains an academic job profile based on the Work Keys system that identifies the level of applied academic skills that students must master to qualify for and be successful in their occupations; a total list of academic competencies in communication, mathematics, and science that all students should master; and a specific list of academic competencies for environmental management. (YLB)

ED 388 864

OCAP

OCCUPATIONAL COMPETENCY ANALYSIS PROFILE

ENVIRONMENTAL MANAGEMENT

U.S. DEPARTMENT OF EDUCATION
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Introduction

What is an OCAP?

According to the *Action Plan for Accelerating the Modernization of Vocational Education: Ohio's Future at Work*—

> A comprehensive and verified employer competency list will be developed and kept current for each program
>
> —Imperative 3, Objective 2—

The Occupational Competency Analysis Profiles (OCAPs) are the Ohio Division of Vocational and Adult Education's response to that objective.

OCAPs are competency lists—verified by expert workers—that evolve from a modified DACUM job analysis process involving business, industry, labor, and community agency representatives from throughout Ohio. The OCAP process is directed by the Vocational Instructional Materials Laboratory located at The Ohio State University's Center on Education and Training for Employment.

How is the OCAP used?

Each OCAP identifies the occupational, academic, and employability skills (or competencies) needed to enter a given occupation or occupational area. The OCAP not only lists the *competencies* but also clusters those competencies into broader *units* and details the knowledge, skills, and attitudes (*competency builders*) needed to perform each competency.

Within the competency list are two levels of items: core and advancing. *Core items*, which are essential for entry-level employment, are required to be taught and are the basis for questions on the Ohio Vocational Competency Assessment (OVCA). *Advancing items* (marked with an asterisk) are those needed to advance in a given occupation.

School districts may add as many units, competencies, and/or competency builders as desired to reflect local employment needs, trends, and specialties. Local advisory committees should be actively involved in the identification and verification of additional items. Vocational and applied academic instructors will be able to formulate their courses of study using the varied contents of the OCAP and will be able to monitor competency gains via the new criterion-referenced competency testing program, which is tied to the competencies identified on the OCAP.

Notes

Occupational Competency Analysis Profile:

Environmental Management

Unit 1: General Safety and Health

Competency 1.1: Maintain safe work environment

Competency Builders:

1.1.1 Comply with shop and equipment safety rules
1.1.2 Maintain clean and safe work area
1.1.3 Install safety devices
1.1.4 Maintain safety devices (e.g., fire extinguishers, emergency flush showers)
1.1.5 Locate material safety data sheets (MSDSs) or equivalent Health Material Information System (HMIS)
1.1.6 Monitor regulation updates*
1.1.7 Define the purpose of MSDSs or HMIS
1.1.8 Follow safety information contained in MSDSs/HMIS and other safety guidelines established for the workplace
1.1.9 Identify the location of hazardous materials
1.1.10 Store hazardous materials according to manufacturer's specifications
1.1.11 Describe the reporting and corrective actions to be taken in a given hazardous situation
1.1.12 Correct safety hazards
1.1.13 Describe the procedures for cleaning up leaks and spills
1.1.14 Clean up leaks and spills
1.1.15 Comply with responder first-aid and cardiopulmonary resuscitation certification standards
1.1.16 Describe injury and accident reporting system
1.1.17 Complete accident reports

Competency 1.2: Practice safe work habits

Competency Builders:

1.2.1 Follow worksite code governing dress, grooming, and wearing of personal accessories (e.g., jewelry)
1.2.2 Wear personal protective equipment (e.g., safety glasses, ear protectors)
1.2.3 Check working condition of personal protective equipment (PPE)
1.2.4 Follow label information
1.2.5 Follow ergonomic safety requirements
1.2.6 Interpret information on signs
1.2.7 Observe safety precautions when storing chemicals and fertilizer
1.2.8 Follow procedures for personal cleanup after handling chemicals and fertilizer
1.2.9 Respond to emergency and nonemergency signals (e.g., audible alarms, warning lights) according to established procedures

Competency 1.3: Follow established procedures for the operation and maintenance of equipment

Competency Builders:

1.3.1 Follow state, federal, and/or manufacturer's safety guidelines for equipment operation and maintenance
1.3.2 Perform preoperative check on equipment
1.3.3 Comply with safety zones around equipment
1.3.4 Establish safety zones around equipment*
1.3.5 Operate equipment defensively
1.3.6 Interpret safety symbols and signs (e.g., slow-moving-vehicle sign)
1.3.7 Maintain equipment safety shields
1.3.8 Disable power equipment before servicing (i.e., shut down and lock-out/tag-out)
1.3.9 Identify potential equipment safety hazards
1.3.10 Correct potential equipment safety hazards
1.3.11 Perform preventive maintenance checks on equipment
1.3.12 Service equipment in accordance with manufacturer's specifications
1.3.13 Maintain hand and power tools in accordance with manufacturer's specifications

Competency 1.4: Respond to critical incidents

Competency Builders:

1.4.1 Recognize hazardous situations
1.4.2 Report hazardous situations to supervisor
1.4.3 Initiate follow-through procedures
1.4.4 Initiate responses
1.4.5 Complete incident reports

Competency 1.5: Identify medical emergencies

Competency Builders:

1.5.1 Identify various types of medical emergencies and emergency scene assessments
1.5.2 Identify symptoms of various medical emergencies dealing with airway breathing circulation
1.5.3 Identify symptoms of body stress caused by cold
1.5.4 Identify symptoms of body stress caused by heat
1.5.5 Identify symptoms of body stress caused by chemicals
1.5.6 Identify symptoms of body stress caused by radiation
1.5.7 Identify symptoms of body stress caused by biological factors
1.5.8 Identify symptoms of body stress caused by insect bites

Competency 1.6: Respond to medical emergencies

Competency Builders:

1.6.1 Assess emergency scenes
1.6.2 Summon medical assistance
1.6.3 Apply basic first-aid procedures (e.g., for shock, uncontrolled bleeding)
1.6.4 Describe the cardiopulmonary resuscitation (CPR) process
1.6.5 Acquire cardiopulmonary resuscitation (CPR) certification*
1.6.6 Administer first aid for heat stress, hypothermia, frostbite, and cold stress

Unit 2: Worker Health and Safety

Competency 2.1: Identify the Occupational Safety and Health Administration (OSHA) standards for job-related activities

Competency Builders:

2.1.1 Provide an overview of OSHA rules and regulations
2.1.2 Identify the requirements for the control of hazardous energy (OSHA 29 CFR 1910.147)
2.1.3 Identify the requirements for commercial diving operations in the environmental field (OSHA 29 CFR 1910.424)
2.1.4 Interpret OSHA 29 CFR 1910.1000 Z Tables
2.1.5 Identify OSHA requirements applicable to blood-borne pathogens (OSHA 29 CFR 1910.1250)
2.1.6 Identify the requirements set forth under the Hazard Communication Laws and Regulations (OSHA 29 CFR 1910.1200)
2.1.7 Identify the entry conditions for a confined space (OSHA 29 CFR 1910.146)
2.1.8 Identify the noise exposure limits (OSHA 29 CFR 1910.95)
2.1.9 Identify the use and function of portable fire extinguishers (OSHA 29 CFR 1910.157)

Competency 2.2: Identify the basic requirements of the Resource Conservation and Recovery Act (RCRA)

Competency Builders:

2.2.1 Identify the sections of the RCRA
2.2.2 Identify the key components of the RCRA
2.2.3 Identify the RCRA categories of hazardous waste
2.2.4 Interpret OSHA 29 CFR 1910.1000 Z Tables and the Permissible Exposure Limits (PELs) and Threshold Limit Values (TLVs) established by the American Conference of Governmental Industrial Hygienists (ACGIH)
2.2.5 Identify OSHA requirements applicable to blood-borne pathogens (OSHA 29 CFR 1910.1250)
2.2.6 Identify the requirements set forth under the Hazard Communication Laws and Regulations (OSHA 29 CFR 1910.1200)
2.2.7 Describe the "cradle to grave" concept
2.2.8 Identify secondary containment requirements for above- and below-ground storage

Competency 2.3: Identify the basic requirements of the Clean Water Act (CWA)

Competency Builders:

2.3.1 Identify the sections of the CWA
2.3.2 Identify the key components of the CWA
2.3.3 Identify the key components of the National Pollutant Discharge Elimination System (NPDES)
2.3.4 Identify the key components of the 503 Sludge Regulations
2.3.5 Explain the CWA pretreatment program
2.3.6 Describe the Great Lakes Initiative (GLI)

Competency 2.4: Identify the basic requirements of the Safe Drinking Water Act (SDWA)

Competency Builders:

2.4.1 Identify the sections of the SDWA
2.4.2 Identify the key components of the SDWA
2.4.3 Explain the purpose of the Wellhead Protection Program
2.4.4 Describe the Sole Source Aquifer Designation

Competency 2.5: Identify the basic requirements of the Clean Air Act (CAA)

Competency Builders:

2.5.1 Identify the sections of the CAA
2.5.2 Identify the key components of the CAA
2.5.3 Explain the Title V Air Emissions Inventory
2.5.4 Define *hazardous air pollutants* (HAPs)

Competency 2.6: Complete the requirements for Hazardous Materials Technician I, II, and III *(OSHA 29 CFR 1910.120 [e] [2])*

Competency Builders:

2.6.1 Follow the procedures identified in the emergency response plan
2.6.2 Use personal protective equipment (PPE) appropriate for given situation
2.6.3 Identify need for additional resources
2.6.4 Follow basic control containment and confinement procedures
2.6.5 Follow advanced control containment and confinement procedures
2.6.6 Perform assigned role in simulated emergency response situations
2.6.7 Function in the role of Incident Command System (ICS) Level II Technician
2.6.8 Identify the presence of hazardous materials
2.6.9 Identify known and unknown hazardous materials and their classifications
2.6.10 Demonstrate basic hazard and risk assessment techniques
2.6.11 Interpret basic hazardous material terminology
2.6.12 Interpret chemical and toxicology terminology
2.6.13 Identify symptoms indicating exposure to toxic and nontoxic chemicals
2.6.14 Implement decontamination procedures
2.6.15 Develop standard operating and termination procedures
2.6.16 Terminate procedures

Competency 2.7: Identify the basic requirements of the Nuclear Waste Policy Act

Competency Builders:

2.7.1 Identify the key provisions of the Nuclear Waste Policy Act
2.7.2 Identify the key agencies involved in the high-level radioactive waste management program
2.7.3 Identify the defining characteristics of the four categories of nuclear waste
2.7.4 Identify the established method of disposal for each category of nuclear waste
2.7.5 Identify storage locations for each type of nuclear waste

Unit 3: Environmental Industrial Technology

Competency 3.1: Demonstrate knowledge of the environmental industry

Competency Builders:

3.1.1 Identify the fields of endeavor within the industry
3.1.2 Identify the economic importance of the industry
3.1.3 Identify the environmental importance of the industry
3.1.4 Identify employment opportunities within the industry
3.1.5 Identify the regulatory aspects of the industry
3.1.6 Identify continuing education opportunities within the industry
3.1.7 Identify professional organizations and trade journals for the industry
3.1.8 Identify state licensing requirements related to the industry

Competency 3.2: Demonstrate knowledge of environmental chemistry
(OSHA 29 CFR 1910.1450)

Competency Builders:

3.2.1 Identify the requirements of a chemical hygiene plan
3.2.2 Identify the responsibilities of a chemical hygiene plan
3.2.3 Identify the responsibilities of a chemical hygiene officer
3.2.4 Identify the responsibilities of individuals involved with chemicals on a small scale
3.2.5 Identify the functions of a chemical technician
3.2.6 Identify the basic chemistry skills needed by a chemical technician
3.2.7 Interpret key terminology related to environmental chemistry
3.2.8 Identify the basic laboratory techniques and procedures used by a chemical technician
3.2.9 Identify the primary factors that produce a fire
3.2.10 Identify the physical states in which ignitable materials may be found
3.2.11 Identify the most frequently encountered ways of producing heat
3.2.12 Identify means of removing one of the three sides of a fire triangle
3.2.13 Identify the four classifications of fire

Competency 3.3: Demonstrate knowledge of environmental toxicology

Competency Builders:

3.3.1 Identify the routes by which toxic substances enter the body and examples of each route
3.3.2 Describe the process of bioaccumulation, especially within aquatic food webs
3.3.3 Differentiate between chronic and acute exposure to toxins
3.3.4 Provide examples of both chronic and acute exposure to toxins
3.3.5 Describe the LD/LC 50 principle
3.3.6 Provide examples illustrating how the LD/LC 50 principle helps reduce toxic exposures
3.3.7 Differentiate between carcinogens, mutagens, and teratogens
3.3.8 Identify types of carcinogen effects
3.3.9 Identify types of mutagen effects
3.3.10 Identify types of teratogen effects
3.3.11 Outline the body's natural defense mechanisms
3.3.12 Identify means of assessing the risks related to toxicology and humans
3.3.13 Identify ways to explain the risks related to toxicology and humans
3.3.14 Differentiate between the individual risks and societal risks associated with toxic substances

Unit 4: Pollution Prevention and Assessment

Competency 4.1: Determine possible point and nonpoint sources of pollution

Competency Builders:

4.1.1 Identify the primary pollution media (air, water, etc.)
4.1.2 Identify the causes of point source pollution
4.1.3 Identify the causes of nonpoint source pollution
4.1.4 Identify possible cross-media pollution transfer
4.1.5 Identify the potential receptors of pollution

Competency 4.2: Determine management procedures for point and nonpoint sources of pollution

Competency Builders:

4.2.1 Describe the hierarchy of waste disposal management
4.2.2 Identify best management practices (BMPs) for reducing nonpoint pollution
4.2.3 Demonstrate knowledge of risk assessment procedures
4.2.4 Identify waste reduction principles
4.2.5 Describe the regulatory requirements for pollution prevention

Unit 5: Environmental Ecology Basics

Competency 5.1: Identify current science, public policy, and economic issues

Competency Builders:

5.1.1 Identify ways in which humans are an integral part of nature
5.1.2 Explain how environmental issues are created and resolved by economic and/or political decisions
5.1.3 Identify the interacting spheres that make up our ecosphere
5.1.4 Identify the characteristics of the scientific method
5.1.5 Explain the rationale for comparing a controlled system against an uncontrolled system

Competency 5.2: Explain the interplay of politics and economics relative to environmental problems

Competency Builders:

5.2.1 Identify the environmental topics included in recently passed legislation
5.2.2 Identify the methods governmental agencies use to arrive at decisions affecting the environment
5.2.3 Identify the constituencies that politicians must take into consideration before arriving at decisions
5.2.4 Explain the reasons why incremental decision making prevails over holistic solutions to problems
5.2.5 Identify the competing interests of economists and ecologists
5.2.6 Identify the structures and characteristics of free, mixed, and centralized market economies
5.2.7 Identify the analytical tools employed by economists in decision making

Continued

Competency 5.2: ***Explain the interplay of politics and economics relative to environmental problems—Continued***

5.2.8 Identify the differences and similarities between environmental problems in the United States and those in foreign, particularly less developed, countries

Competency 5.3: Demonstrate basic knowledge of environmental archaeology

Competency Builders:

5.3.1 Identify the fossil rim
5.3.2 Assess previous environmental conditions globally in order to examine evidence about past climates
5.3.3 Compare past climate to present climate
5.3.4 Examine environmental climatic change through microfossils
5.3.5 Compare past environmental changes to potential environmental changes forecasted
5.3.6 Determine the types of vegetation that were encountered by humans in the past
5.3.7 Describe environmental effects on various species of animals that were absent, present, or particularly abundant in certain layers and periods
5.3.8 Identify the most important effects of human interference and exploitation of managed landscapes and natural resources
5.3.9 Identify environmental impact assessment techniques

Competency 5.4: Demonstrate basic knowledge of ecosystems

Competency Builders:

5.4.1 Explain how energy flows through ecosystems
5.4.2 Explain how materials are cycled in ecosystems
5.4.3 Provide examples of the first and second laws of thermodynamics as they occur in ecosystems
5.4.4 Identify the steps in the photosynthesis process
5.4.5 Compare/contrast gross and net photosynthesis
5.4.6 Identify the ways in which efficiency applies to energy flow in food webs
5.4.7 Compare/contrast grazing and detritus food webs
5.4.8 Identify the steps in carbon and oxygen cycles
5.4.9 Explain the interrelationship of carbon and oxygen cycles
5.4.10 Identify the ways in which agricultural systems differ from natural ecosystems
5.4.11 Compare/contrast nitrogen and phosphorus cycles
5.4.12 Identify the ways in which humans have altered chemical cycles
5.4.13 Identify the characteristics of pollution

Competency 5.5: Identify ecological responses to environmental change

Competency Builders:

5.5.1 Identify the processes governing an organism's ability to respond to and survive environmental changes
5.5.2 Provide examples of the law of tolerance and the law of the minimum
5.5.3 Identify the steps in the process of ecological succession
5.5.4 Provide examples of how human activities impact succession
5.5.5 Provide examples of types of adaptation
5.5.6 Identify micro-organisms used to improve our ecology

Competency 5.6: Describe meteorological interactions within the environment

Competency Builders:

5.6.1 Identify the factors that interact to cause weather
5.6.2 Identify the basic methods of heat transfer
5.6.3 Identify the factors that influence air pressure
5.6.4 Compare/contrast local and global wind patterns
5.6.5 Differentiate between cloud types
5.6.6 Compare/contrast the major types of air masses that affect weather in the United States
5.6.7 Differentiate between cold fronts, warm fronts, occluded fronts, and stationary fronts
5.6.8 Explain how the interaction between fronts affects weather patterns
5.6.9 Interpret weather maps
5.6.10 Identify the factors that determine climate and affect temperature and precipitation
5.6.11 Compare/contrast the major climate regions of the United States
5.6.12 Identify the factors that cause the climate to change

Unit 6: Population Growth and Regulation

Competency 6.1: Explain growth processes in natural populations

Competency Builders:

6.1.1 Provide examples of linear and geometric growth patterns
6.1.2 Explain different processes used to measure population growth
6.1.3 Differentiate between density-dependent and density-independent regulation of populations
6.1.4 Provide examples of predation and parasitism
6.1.5 Identify the effects of predation, parasitism, competition, and mutualism on the regulation of the size of natural populations
6.1.6 Identify the physical factors controlling population sizes
6.1.7 Provide examples of the effects of carrying capacity when a species overshoots population limits

Competency 6.2: Identify human population dynamics

Competency Builders:

6.2.1 Identify the factors that have influenced population growth throughout history
6.2.2 Identify the factors influencing population growth in recent times
6.2.3 Calculate population doubling time
6.2.4 Compare/contrast the age-structure diagrams of the United States and other countries
6.2.5 Identify the differences in the effects of a demographic transition on more-developed and less-developed nations
6.2.6 Identify the factors that are considered in calculating total fertility growth (TFG)
6.2.7 Identify the factors that are considered in calculating zero population growth (ZPG)
6.2.8 Explain why population growth occurs even with replacement-level fertility

Unit 7: Land Management and Usage

Competency 7.1: Identify soil characteristics

Competency Builders:

7.1.1 Follow general lab safety precautions
7.1.2 Identify the soil horizons of given soil samples
7.1.3 Calculate land slope
7.1.4 Determine soil texture
7.1.5 Determine soil structure
7.1.6 Determine soil type
7.1.7 Determine soil drainage
7.1.8 Determine soil productivity

Competency 7.2: Conserve soil

Competency Builders:

7.2.1 Determine land capability according to the established classification system
7.2.2 Determine erosion rates
7.2.3 Interpret aerial photos
7.2.4 Interpret soil survey maps
7.2.5 Identify types of erosion
7.2.6 Determine causes of erosion
7.2.7 Select soil erosion-control methods

Unit 8: Surveying and Drafting

Competency 8.1: Conduct basic surveys

Competency Builders:

8.1.1 Follow general safety precautions related to surveying
8.1.2 Measure distances
8.1.3 Measure elevations using a tripod level
8.1.4 Maintain tripod levels
8.1.5 Interpret target rod readings
8.1.6 Communicate with other surveyors using hand signals
8.1.7 Record field notes
8.1.8 Determine allowable error for calculations
8.1.9 Calculate acreage
8.1.10 Draw field layouts
8.1.11 Locate bench marks
8.1.12 Take backsight readings
8.1.13 Take foresight readings
8.1.14 Perform bench level circuit surveys
8.1.15 Measure degree of slope
8.1.16 Record physical and topographical data
8.1.17 Keep up-to-date concerning technological advancements related to conducting surveys

Competency 8.2: Interpret topographic and soil maps, aerial photographs, and legal descriptions

Competency Builders:

8.2.1 Follow general safety precautions related to surveying
8.2.2 Interpret legal land descriptions
8.2.3 Interpret map symbols
8.2.4 Interpret map legends
8.2.5 Identify true and magnetic north
8.2.6 Draw profiles using contour lines
8.2.7 Demonstrate knowledge of how to operate computer-aided design (CAD) systems
8.2.8 Complete drawings using a CAD system*
8.2.9 Measure distances
8.2.10 Identify terrain types
8.2.11 Interpret elevations
8.2.12 Identify direction of water flow
8.2.13 Calculate area
8.2.14 Identify the location of field boundaries
8.2.15 Establish field boundaries
8.2.16 Interpret topical and aerial photographs
8.2.17 Calculate acreage based on field measurements
8.2.18 Prepare land capability maps from soil maps and data
8.2.19 Measure stream flow

Competency 8.3: Orient to field position

Competency Builders:

8.3.1 Follow general safety precautions related to field work
8.3.2 Follow compass course
8.3.3 Locate objects in the field
8.3.4 Orient compass to topographic maps
8.3.5 Adjust compass to local declination
8.3.6 Use back bearings
8.3.7 Pace out distances
8.3.8 Calculate area
8.3.9 Measure distance
8.3.10 Draw field layouts
8.3.11 Draw metes and bounds
8.3.12 Describe Global Positioning System (GPS)
8.3.13 Describe Geographic Information System (GIS)
8.3.14 Access needed information using the GPS*
8.3.15 Access needed information using the GIS*

Unit 9: Groundwater Geology

Competency 9.1: Demonstrate knowledge of the basic concepts of glacial geology

Competency Builders:

9.1.1 Develop a chronology of the events associated with glacial advancements
9.1.2 Describe glacial till
9.1.3 Describe outwash deposits and their relevance to groundwater
9.1.4 Describe valley train deposits and their impact on groundwater flow
9.1.5 Describe glacial kames, their origins, and resulting land forms
9.1.6 Describe the characteristics and origins of glacial moraines
9.1.7 Describe the characteristics and origins of glacial drumlins
9.1.8 Describe how glacial advancements reshaped the landscape resulting in present-day drainage patterns (watershed)

Competency 9.2: Demonstrate knowledge of the basic concepts of hydrogeology

Competency Builders:

9.2.1 Create cross-sectional diagrams from information provided
9.2.2 Differentiate between a cross-sectional diagram and a fence diagram
9.2.3 Create potentiometric maps from information provided
9.2.4 Determine the direction of groundwater flow from information provided
9.2.5 Create vertical and horizontal isoconcentration maps from information provided
9.2.6 Take groundwater levels from designated monitoring wells or piezometers
9.2.7 Determine vertical gradients from the given groundwater level of a three-well nest
9.2.8 Describe buried valley aquifers and the significance of the "deep stage"
9.2.9 Describe Karst topography
9.2.10 Describe sinkholes, their origins, and implications relative to their surface stability
9.2.11 Interpret key hydrogeology terminology (e.g., sole source aquifer, isotropy, anisotropy, homogeneity, heterogeneity, losing stream, gaining stream, well field, recharge lagoon, groundwater divide, permeability, effective porosity)
9.2.12 Identify the components of Darcy's Law
9.2.13 Describe cones of depression in words and pictures
9.2.14 Describe zones of contribution in words and pictures
9.2.15 Describe zones of influence in words and pictures

Competency 9.3: Demonstrate knowledge of the basic concepts of wellhead protection

Competency Builders:

9.3.1 Identify the various groundwater modeling methods of wellhead delineation
9.3.2 Provide examples of conceptual groundwater models
9.3.3 Describe a numerical groundwater model
9.3.4 Identify the parameters and software packages required to implement a numerical (analytical) groundwater model
9.3.5 Provide examples of groundwater boundaries

Competency 9.4: Demonstrate knowledge of the basic concepts of hydrogeological chemistry*

Competency Builders:

9.4.1 Explain the purpose of a fate transport model*
9.4.2 Describe the implications associated with dense non-aqueous phase liquids (DNAPLs)*
9.4.3 Explain the significance of chlorinated hydrocarbons found in groundwater*
9.4.4 Describe maximum containment levels (MCLs)*

Competency 9.5: Demonstrate knowledge of the basic concepts of environmental drilling

Competency Builders:

9.5.1 Complete boring/well logs from information provided
9.5.2 Complete well construction diagrams from information provided
9.5.3 Identify the environmental drilling methods associated with the installation of monitoring wells and piezometers
9.5.4 Complete gamma logs
9.5.5 Identify the methods used in developing a monitoring well
9.5.6 Explain the purpose of a telescoping well

Competency 9.6: Identify methods of groundwater treatment and remediation

Competency Builders:

9.6.1 Explain the purpose of an air stripping facility
9.6.2 Explain the purpose of a granular activated carbon facility
9.6.3 Describe groundwater sparging
9.6.4 Explain the purpose of a slurry wall or grout curtain
9.6.5 Explain the sole purpose of a gradient control (interceptor) well and its relationship with groundwater remediation methods

Unit 10: Investigation of Environmental Concerns

Competency 10.1: Perform site assessments (Phase I)

Competency Builders:

10.1.1 Identify the key elements in Phase I assessments
10.1.2 Describe the importance of conducting a title search
10.1.3 Complete title searches
10.1.4 Gather drainage area data
10.1.5 Complete field data sheets
10.1.6 Record physical and topographical data
10.1.7 Interpret basic soil differences
10.1.8 Measure groundwater levels
10.1.9 Identify flood plain areas
10.1.10 Measure stream flow
10.1.11 Calculate water runoff

Competency 10.2: Identify past practices affecting the environment

Competency Builders:

10.2.1 Locate regulatory reference materials
10.2.2 Access needed information using regulatory reference materials
10.2.3 Collect background information
10.2.4 Verify the accuracy of information collected
10.2.5 Investigate the background of each complaint
10.2.6 Interact with various regulatory agencies

Competency 10.3: Conduct lab/field analyses

Competency Builders:

10.3.1 Perform Biochemical Oxygen Demand (BOD) analyses
10.3.2 Perform Chemical Oxygen Demand (COD) analyses
10.3.3 Perform pH analyses
10.3.4 Perform specific conductivity analyses
10.3.5 Perform dissolved oxygen analyses
10.3.6 Perform suspended solids analyses
10.3.7 Measure water temperature
10.3.8 Measure water hardness
10.3.9 Measure water level and flow
10.3.10 Perform nitrates and nitrites analyses
10.3.11 Measure turbidity
10.3.12 Measure oxygen levels
10.3.13 Measure Lower Explosive Levels (LELs)*
10.3.14 Measure air flow rate and temperature
10.3.15 Perform air particulate analyses
10.3.16 Describe the procedures for measuring toxic gases
10.3.17 Describe the procedures for measuring organic vapors
10.3.18 Describe the procedures for measuring radiation
10.3.19 Measure toxic gases*
10.3.20 Measure organic vapors*
10.3.21 Measure basic field levels of contamination
10.3.22 Measure radiation*
10.3.23 Measure radon
10.3.24 Measure flashpoint
10.3.25 Measure free liquids
10.3.26 Perform percolation tests
10.3.27 Determine moisture content/dry content (DC)
10.3.28 Measure density
10.3.29 Measure chlorinated compounds
10.3.30 Identify background analytical data to establish norm for site

Competency 10.4: Collect physical data (Phase II)

Competency Builders:

10.4.1 Identify the key elements in Phase II assessments
10.4.2 Identify safety hazards associated with given materials
10.4.3 Develop Chain of Custody procedures
10.4.4 Identify physical condition of given materials
10.4.5 Identify marking procedures
10.4.6 Select sampling tools
10.4.7 Identify preparation and preservation procedures to be used for samples
10.4.8 Collect samples
10.4.9 Label samples
10.4.10 Document samples using Chain of Custody forms
10.4.11 Sign over Chain of Custody forms

Competency 10.5: Remediate site (Phase III)

Competency Builders:

10.5.1 Identify the key elements in Phase III assessments
10.5.2 Identify options for corrective actions
10.5.3 Resolve issues with concerned parties
10.5.4 Assess options for corrective action
10.5.5 Implement selected remediation option
10.5.6 Document investigations with summary reports

Unit 11: Management of Biological Resources and Environmental Quality

Competency 11.1: Identify global food resources and hunger

Competency Builders:

11.1.1 Differentiate between malnutrition and undernutrition
11.1.2 Identify food resource problems within rain forests and semiarid lands
11.1.3 Identify the variables that control agricultural production
11.1.4 Identify reasons for maintaining soil quality
11.1.5 Identify the characteristics of crop irrigation management
11.1.6 Identify ways in which biotechnology may influence the future of agricultural science
11.1.7 Identify the problems associated with harvesting oceans
11.1.8 Identify aquaculture successes and limitations

Competency 11.2: Identify pest-management methods

Competency Builders:

11.2.1 Identify the characteristics of various pest species
11.2.2 Identify the goals of pest-eradication programs in the United States
11.2.3 Identify the impact of this nation's pest-eradication programs on the environment
11.2.4 Describe the various types of pesticides

Continued

Competency 11.2: Identify pest-management methods—Continued

11.2.5 Describe the pros and cons of synthetic pesticide use
11.2.6 Identify alternative pest-control measures
11.2.7 Describe the environmental impact of different types of pest-control measures
11.2.8 Identify the steps in the evolution of natural pesticides
11.2.9 Identify the strengths and weaknesses of using sex attractants, growth regulators, and sterilization to control insect pests
11.2.10 Identify disease-resistant cultivars
11.2.11 Identify pest-management techniques
11.2.12 Identify the components of an integrated pest-management program
11.2.13 Describe the pesticide applicators' certification process
11.2.14 Obtain a pesticide applicators' license*
11.2.15 Recognize pest damage
11.2.16 Identify disease organism structures
11.2.17 Estimate pest population numbers

Competency 11.3: Assist in managing wildlife population growth and reproduction

Competency Builders:

11.3.1 Identify the private, state, and federal agencies that are involved in animal wildlife conservation
11.3.2 Identify the species of land and aquatic wildlife common to a local area
11.3.3 Classify common species of land and aquatic wildlife as game, nongame, endangered, or threatened
11.3.4 Identify the characteristics of wildlife population dynamics
11.3.5 Identify established management practices for wildlife habitats
11.3.6 Comply with wildlife, game, and fishing laws, rules, and regulations
11.3.7 Identify pests, insects, and diseases associated with common wildlife
11.3.8 Identify the characteristics of wildlife populations

Unit 12: Land Reclamation*

Competency 12.1: Manage reclamation equipment and instruments*

Competency Builders:

12.1.1 Identify types of land reclamation problems*
12.1.2 Comply with established laws and regulations concerning the use of reclamation equipment and instruments*
12.1.3 Use reclamation potentials of earthmoving equipment*
12.1.4 Schedule equipment and materials*
12.1.5 Interpret photos and maps*
12.1.6 Demonstrate the use of revegetation equipment*
12.1.7 Demonstrate the use of drafting equipment*
12.1.8 Demonstrate the use of surveying equipment*
12.1.9 Demonstrate the use of hand tools*
12.1.10 Demonstrate the use of small power tools*

Competency 12.2: Monitor soil quality and quantity*

Competency Builders:

12.2.1 Comply with established laws and regulations concerning the treatment of soils*
12.2.2 Interpret soil surveys*
12.2.3 Identify soil types*
12.2.4 Collect soil samples*
12.2.5 Take actions needed as indicated by soil sample results*
12.2.6 Coordinate stripping, stockpiling, and redistribution of topsoils and/or overburden*
12.2.7 Coordinate final gradings and shaping*
12.2.8 Apply fertilizers and soil amendments*
12.2.9 Minimize effects of wind and water erosion*

Competency 12.3: Monitor water quality and quantity*

Competency Builders:

12.3.1 Comply with established laws and regulations concerning the treatment of water*
12.3.2 Collect water samples*
12.3.3 Analyze samples for water quality*
12.3.4 Measure water quantities*
12.3.5 Implement pollution abatement measures*
12.3.6 Identify types of well construction and development*
12.3.7 Control fugitive dusts*
12.3.8 Identify Class I, Class II, and Class III macroinvertebrates*
12.3.9 Explain the importance of macroinvertebrates as indicators of water quality*

Competency 12.4: Develop vegetation/revegetation requirements and plans*

Competency Builders:

12.4.1 Comply with established laws and regulations concerning vegetation/revegetation*
12.4.2 Identify plants*
12.4.3 Conduct vegetation inventories*
12.4.4 Transplant vegetation*
12.4.5 Establish test plots*
12.4.6 Identify nutrient deficiencies of vegetation*
12.4.7 Maintain revegetated areas*
12.4.8 Prepare seedbeds*
12.4.9 Mix seeds*
12.4.10 Inoculate seeds*
12.4.11 Calibrate seeding equipment*
12.4.12 Supervise seeding and planting operations*
12.4.13 Supervise mulching operations*
12.4.14 Apply fertilizers and soil amendments*
12.4.15 Maintain irrigation systems*
12.4.16 Monitor soil stabilities*
12.4.17 Monitor plant establishments*
12.4.18 Apply animal control measures*
12.4.19 Supervise maintenance programs*

Unit 13: Environmental Laws and Regulations

Competency 13.1: **Identify the basic requirements of the Comprehensive Environmental Responsibility Compensation and Liability Act (CERCLA)**

Competency Builders:

13.1.1 Identify the sections of the CERCLA
13.1.2 Identify the key parts of CERCLA site evaluation and remedy selection
13.1.3 Identify the scores involved with the hazard ranking system and their characteristics
13.1.4 Identify national priority sites (NPLs)
13.1.5 Identify key elements of the Toxic Substance Control Act relative to the CERCLA

Competency 13.2: **Identify the basic requirements of the Superfund Amendment Reauthorization Act (SARA)**

Competency Builders:

13.2.1 Identify the sections of the SARA
13.2.2 Identify the key parts of the SARA
13.2.3 Explain the Toxic Release Inventory (TRI)
13.2.4 Locate a list of SARA sites

Unit 14: Practical Application of Environmental Regulatory Requirements

Competency 14.1: **Manage water systems**

Competency Builders:

14.1.1 Complete water quality assessments on local surface water bodies
14.1.2 Complete groundwater quality assessments within wellhead protection areas
14.1.3 Develop NPDES plans for construction sites
14.1.4 Complete surface water assessments within watersheds
14.1.5 Develop primary and secondary containment systems
14.1.6 Determine the efficiency of treatment facilities
14.1.7 Conduct sediment studies to determine best management practices (BMPs)

Competency 14.2: **Manage air systems**

Competency Builders:

14.2.1 Conduct air emission inventories
14.2.2 Monitor indoor air quality
14.2.3 Assess pollution control systems
14.2.4 Monitor auto emissions
14.2.5 Monitor volatile organic compounds (VOCs)

Competency 14.3: Manage solid waste systems

Competency Builders:

14.3.1 Select municipal solid waste (MSW) sites
14.3.2 Audit MSW sites
14.3.3 Identify resources available through recycled solid waste sites
14.3.4 Draft proposals to improve the management of solid wastes
14.3.5 Develop/maintain satellite accumulation areas
14.3.6 Draft chemical hygiene plans (OSHA 29 CFR 1910.1450)

Competency 14.4: Assist in determining the quality and quantity of water resources

Competency Builders:

14.4.1 Identify the hydrologic cycle and major uses for water
14.4.2 Assist in identifying present and potential sources of water pollution in a local area
14.4.3 Assist in determining the quality of given samples of water
14.4.4 Calculate the volume and surface area of ponds, lakes, and streams
14.4.5 Assist in planning improvements for waterways, ponds, stream banks, and shorelines

Unit 15: Business Management

Competency 15.1: Manage information manually

Competency Builders:

15.1.1 Organize information in systematic fashion
15.1.2 Process information in systematic fashion
15.1.3 Maintain information in systematic fashion
15.1.4 Determine need for data
15.1.5 Obtain data from existing sources
15.1.6 Evaluate relevancy and accuracy of data (e.g., taxes, law, insurance)
15.1.7 Identify types of business documents
15.1.8 Convey information to others (e.g., oral presentations, written communications)
15.1.9 Incorporate multimedia in communications
15.1.10 Determine the impact of demographic trends on business
15.1.11 Explain the importance of product and/or service development, marketing, advertising, and selling
15.1.12 Interpret policies and procedures
15.1.13 Provide input into the development of policies and procedures
15.1.14 Establish policies and procedures*
15.1.15 Develop business meeting agendas*
15.1.16 Conduct business meetings*
15.1.17 Participate in team building

Competency 15.2: Allocate resources

Competency Builders:

15.2.1 Prioritize goal-related activities
15.2.2 Allocate time to activities
15.2.3 Follow established schedules
15.2.4 Identify sources of capital
15.2.5 Forecast future budgetary needs
15.2.6 Prepare budgets*
15.2.7 Analyze financial statements
15.2.8 Match employee abilities with workload demands*
15.2.9 Evaluate own performance
15.2.10 Evaluate employee performance*
15.2.11 Provide feedback to employees on their performance*

Competency 15.3: Analyze business management systems

Competency Builders:

15.3.1 Compare/contrast types of business ownership (e.g., sole proprietorship, partnership, corporation)
15.3.2 Differentiate organizational levels and responsibilities using an organizational chart
15.3.3 Identify business trends
15.3.4 Gather information about how given business management systems are intended to function
15.3.5 Monitor system performance
15.3.6 Correct deviations in intended performance of systems
15.3.7 Interpret economic indicators relative to own career area
15.3.8 Identify local, state, and national regulations with which a manager should be familiar

Competency 15.4: Apply technology to tasks

Competency Builders:

15.4.1 Select procedures, tools, or machines (including computers and programmable logic controls) to produce desired results
15.4.2 Monitor procedures, tools, or machines
15.4.3 Adjust procedures, tools, or machines to improve efficiency
15.4.4 Identify the impact of new technology on the workforce

Competency 15.5: Apply communication skills

Competency Builders:

15.5.1 Follow written and oral instructions
15.5.2 Choose appropriate language (e.g., non-gender-specific, without cultural bias)
15.5.3 Access information via telephone (domestic/international)
15.5.4 Apply established procedures for answering and placing calls via telephone, paging system, or other form of communication system
15.5.5 Send/receive telephone messages
15.5.6 Verify accuracy of telephone messages sent or received
15.5.7 Organize fax communications
15.5.8 Transmit fax communications
15.5.9 Receive fax communications
15.5.10 Use e-mail to organize, send, and receive messages and related information
15.5.11 Use voice mail to give, receive, and route information
15.5.12 Compare available communications services
15.5.13 Identify alternative types/forms of communication
15.5.14 Compose business correspondence
15.5.15 Edit business correspondence according to established rules for grammar, spelling, and punctuation
15.5.16 Access needed information using professional and technical references
15.5.17 Present information orally

Competency 15.6: Prepare oral and written reports

Competency Builders:

15.6.1 Write inspection reports
15.6.2 Document daily work activities
15.6.3 Document work activities using photos
15.6.4 Prepare visual aids
15.6.5 Present oral reports
15.6.6 Assist in completing permit applications
15.6.7 Assist in completing compliance reports
15.6.8 Record baseline data

Competency 15.7: Work with others

Competency Builders:

15.7.1 Work with regulatory agencies
15.7.2 Supervise work crews
15.7.3 Work with management
15.7.4 Work with labor
15.7.5 Coordinate activities of contractors and research agencies
15.7.6 Implement company policies and procedures
15.7.7 Identify team-building processes (e.g., TQM, TQL, CPZ)

Competency 15.8: Manage information using computer applications

Competency Builders:

15.8.1 Identify computer components and their functions
15.8.2 Compare features of different word processing software packages
15.8.3 Explain reasons for upgrading computer hardware and software
15.8.4 Prepare business-related documents using the basic features of word processing software (e.g., indent, block, move, copy)
15.8.5 Prepare business-related documents using the advanced features of word processing software (e.g., tables, merge, graphics)
15.8.6 Enter information on spreadsheets
15.8.7 Revise information on spreadsheets
15.8.8 Design spreadsheets
15.8.9 Prepare charts, graphs, and other graphic material
15.8.10 Enter information into databases
15.8.11 Revise information in databases
15.8.12 Access data in databases
15.8.13 Extract data from databases
15.8.14 Design databases (structure, format, attributes)
15.8.15 Import files from different software packages
15.8.16 Perform basic computer functions using operating system commands
15.8.17 Manage disk directories
15.8.18 Produce documents using desktop publishing software
15.8.19 Identify the features of computer networks
15.8.20 Access information services (e.g., electronic bulletin boards)
15.8.21 Transmit/receive information using information services
15.8.22 Scan text and graphics from print materials
15.8.23 Create forms using electronic media
15.8.24 Develop data backup procedures
15.8.25 Implement data backup procedures
15.8.26 Prepare electronic visual presentations
15.8.27 Identify the steps in the electronic information cycles
15.8.28 Produce business documents from dictated material
15.8.29 Comply with ethical and legal guidelines for software/data management
15.8.30 Interpret business/technology terminology

Competency 15.9: Apply business management/support skills

Competency Builders:

15.9.1 Perform basic mathematical functions using a calculator
15.9.2 Compare/contrast characteristics of business equipment (e.g., copy machines, fax machines, computers, calculators) prior to making purchasing decisions
15.9.3 Identify equipment maintenance procedures
15.9.4 Process outgoing mail
15.9.5 Process incoming mail
15.9.6 Index records
15.9.7 Code records
15.9.8 Cross-reference records
15.9.9 File records
15.9.10 Retrieve records
15.9.11 Manage filing systems
15.9.12 Maintain supply inventory
15.9.13 Apply ergonomic principles to work environments
15.9.14 Arrange business travel
15.9.15 Schedule meetings and events
15.9.16 Process forms related to product-to-client transactions
15.9.17 Identify future workplace trends

Competency 15.10: Control inventory

Competency Builders:

15.10.1 Follow safety precautions related to the control of inventory
15.10.2 Organize storage areas
15.10.3 Organize sales areas
15.10.4 Conduct physical inventories
15.10.5 Determine quantity of bulk items in inventory
15.10.6 Maintain inventory records manually
15.10.7 Maintain computerized inventory records
15.10.8 Identify minimum inventory levels needed
15.10.9 Report minimum inventory levels needed
15.10.10 Rotate stock

Competency 15.11: Receive merchandise

Competency Builders:

15.11.1 Follow general safety precautions related to the receiving of merchandise
15.11.2 Verify orders
15.11.3 Unpack merchandise
15.11.4 Interpret packing slips and invoices
15.11.5 Check merchandise for shipping discrepancies and damage
15.11.6 Distribute merchandise to designated locations
15.11.7 Maintain computerized receiving records
15.11.8 Report damage and shipping discrepancies to supervisor

Competency 15.12: Ship merchandise

Competency Builders:

15.12.1 Follow general safety precautions related to the shipping of merchandise
15.12.2 Determine delivery routes
15.12.3 Record shipments
15.12.4 Load merchandise
15.12.5 Secure loads
15.12.6 Follow government shipping regulations (International Air Transportation [IATA], Department of Transportation [DOT])
15.12.7 Prepare shipping documents
15.12.8 Arrange deliveries
15.12.9 Process special orders
15.12.10 Process returns to vendors
15.12.11 Box shipments
15.12.12 Label boxes

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Occupational Competency Analysis Profile:

Employability

Unit 1: Career Development

Competency 1.1: Investigate career options

Competency Builders:

1.1.1 Determine interests and aptitudes
1.1.2 Identify career options
1.1.3 Research interests, knowledge, abilities, and skills needed in an occupation
1.1.4 Select careers that best match interests and aptitudes
1.1.5 Identify advantages and disadvantages of career options, including self-employment and nontraditional careers

Competency 1.2: Utilize career information

Competency Builders:

1.2.1 Identify a range of career information resources
1.2.2 Use a range of resources to obtain career information (e.g., handbooks, career materials, labor market information, and computerized career-information delivery systems)
1.2.3 Demonstrate knowledge of various classification systems that categorize occupations and industries (e.g., *Dictionary of Occupational Titles*)
1.2.4 Describe the educational requirements of various occupations
1.2.5 Identify individuals in selected occupations as possible information resources, role models, or mentors
1.2.6 Describe the impact of factors such as population, climate, employment trends, and geographic location on occupational opportunities
1.2.7 Assess differences in the wages, benefits, annual incomes, cost of living, and job opportunties associated with selected career options
1.2.8 Determine labor market projections for selected career options

Competency 1.3: Participate in a career exploration activity

Competency Builders:

1.3.1 Identify career exploration activities (e.g., job shadowing, mentoring, volunteer experiences, part-time employment, and cooperative education)
1.3.2 Compare traits, skills, and characteristics required for specific career choices with individual's traits, skills, and characteristics
1.3.3 Recognize potential conflicts between personal characteristics and career choice areas
1.3.4 Describe the impact of exploration activities on current career choices

Competency 1.4: Assess the relationship between educational achievement and career planning

Competency Builders:

1.4.1 Describe how skills developed in academic and vocational programs relate to career goals
1.4.2 Describe how education relates to the selection of a college major, further training, and/or entry into the job market
1.4.3 Identify skills that can apply to a variety of occupational requirements
1.4.4 Explain the importance of possessing learning skills in the workplace

Competency 1.5: Develop an individual career plan

Competency Builders:

1.5.1 Identify career goal(s)
1.5.2 Identify worker conditions, education, training, and employment opportunities related to selected career goal(s)
1.5.3 Describe school and community resources available to help achieve career goal(s)
1.5.4 Identify career ladders possible within selected career goal(s)*
1.5.5 Identify additional experiences needed to move up identified career ladders*
1.5.6 Recognize that changes may require retraining and upgrading of employees' skills

Competency 1.6: Annually review/revise the individual career plan

Competency Builders:

1.6.1 Identify experiences that have reinforced selection of the specific career goal(s) listed on the individual career plan
1.6.2 Identify experiences that have changed the specific career goal(s) listed on the individual career plan
1.6.3 Modify the career goals(s) and educational plans on the individual career plan
1.6.4 Ensure that parents or guardians provide input into the individual career plan process
1.6.5 Identify the correlation between the individual career plan and the actual courses to be taken in high school
1.6.6 Identify the correlation between the individual career plan and postsecondary training, adult education, or employment

Unit 2: Decision Making and Problem Solving

Competency 2.1: Apply decision-making techniques in the workplace

Competency Builders:

2.1.1 Identify the decision to be made
2.1.2 Compare alternatives
2.1.3 Determine the consequences of each alternative
2.1.4 Make decisions based on values and goals
2.1.5 Evaluate the decision made

Competency 2.2: Apply problem-solving techniques in the workplace

Competency Builders:

2.2.1 Diagnose the problem, its urgency, and its causes
2.2.2 Identify alternatives and their consequences in relation to the problem
2.2.3 Recognize multicultural and nonsexist dimensions of problem solving
2.2.4 Explore possible solutions to the problem using a variety of resources
2.2.5 Compare/contrast the advantages and disadvantages of each solution
2.2.6 Determine appropriate action
2.2.7 Implement action
2.2.8 Evaluate results of action implemented

Unit 3: Work Ethic

Competency 3.1: Evaluate the relationship of self-esteem to work ethic

Competency Builders:

3.1.1 Identify special characteristics and abilities in self and others
3.1.2 Identify internal and external factors that affect self-esteem
3.1.3 Identify how individual characteristics relate to achieving personal, social, educational, and career goals
3.1.4 Identify the relationship between personal behavior and self-concept

Competency 3.2: Analyze the relationship of personal values and goals to work ethic both in and out of the workplace

Competency Builders:

3.2.1 Distinguish between values and goals
3.2.2 Determine the importance of values and goals
3.2.3 Evaluate how one's values affect one's goals
3.2.4 Identify own short- and long-term goals
3.2.5 Prioritize own short- and long-term goals
3.2.6 Identify how one's values are reflected in one's work ethic
3.2.7 Identify how interactions in the workplace affect one's work ethic
3.2.8 Identify how life changes affect one's work ethic

Competency 3.3: Demonstrate work ethic

Competency Builders:

3.3.1 Examine factors that influence work ethic
3.3.2 Display initiative
3.3.3 Demonstrate dependable attendance and punctuality
3.3.4 Demonstrate organizational skills
3.3.5 Adhere to schedules and deadlines
3.3.6 Demonstrate a willingness to learn
3.3.7 Demonstrate a willingness to accept feedback and evaluation
3.3.8 Demonstrate interpersonal skills required for working with and for others
3.3.9 Describe appropriate employer-employee interactions for various situations
3.3.10 Express feelings and ideas in an appropriate manner for the workplace

Competency 3.4: Demonstrate safety skills

Competency Builders:

3.4.1 Practice safe work habits
3.4.2 Identify safety hazards
3.4.3 Employ preventative safety measures
3.4.4 Demonstrate appropriate care and use of equipment and facilities to ensure safety
3.4.5 Comply with safety and emergency procedures

Unit 4: Job-Seeking Skills

Competency 4.1: Prepare for employment

Competency Builders:

4.1.1 Identify traditional and nontraditional employment sources
4.1.2 Utilize employment sources
4.1.3 Research job opportunities, including nontraditional careers
4.1.4 Interpret equal employment opportunity laws
4.1.5 Explain the critical importance of personal appearance, hygiene, and demeanor throughout the employment process
4.1.6 Prepare for generic employment tests and those specific to an occupation/organization

Competency 4.2: Develop a résumé

Competency Builders:

4.2.1 Identify personal strengths and weaknesses
4.2.2 List skills and/or abilities, career objective(s), accomplishments/achievements, educational background, work experience, volunteer/community contributions, and organizational memberships
4.2.3 Select an acceptable résumé format
4.2.4 Use correct grammar and spelling and concise wording
4.2.5 Secure references
4.2.6 Complete the résumé

Competency 4.3: Complete the job application process

Competency Builders:

4.3.1 Explain the importance of an application form
4.3.2 Obtain job application forms
4.3.3 Demonstrate appropriate behaviors (e.g., personal appearance, hygiene, and demeanor) for obtaining job application forms in person
4.3.4 Describe methods for handling illegal questions on job application forms
4.3.5 Demonstrate legible written communication skills using correct grammar and spelling and concise wording
4.3.6 Return application to appropriate person
4.3.7 Request interview
4.3.8 Follow up on application status

Competency 4.4: Demonstrate interviewing skills

Competency Builders:

4.4.1 Investigate interview procedures
4.4.2 Demonstrate appropriate behaviors (e.g. appearance, hygiene, and demeanor) for the interview
4.4.3 Demonstrate question-and-answer techniques
4.4.4 Demonstrate methods for handling difficult and/or illegal interview questions
4.4.5 Use correct grammar and concise wording

Competency 4.5: Secure employment

Competency Builders:

4.5.1 Identify present and future employment opportunities within an occupation/organization
4.5.2 Research the organization/company
4.5.3 Use follow-up techniques to enhance employment potential
4.5.4 Evaluate job offer(s)
4.5.5 Respond to job offer(s)

Unit 5: Job Retention and Career Advancement Skills

Competency 5.1: Analyze the organizational structure of the workplace

Competency Builders:

5.1.1 Identify employer expectations regarding job performance, work habits, attitudes, personal appearance, and hygiene
5.1.2 Comply with company policies and procedures
5.1.3 Examine the role/relationship between employee and employer
5.1.4 Recognize opportunities for advancement and reasons for termination
5.1.5 Recognize the organization's ethics.

Competency 5.2: Maintain positive relations with others

Competency Builders:

5.2.1 Exhibit appropriate work habits and attitudes
5.2.2 Identify behaviors for establishing successful working relationships
5.2.3 Cooperate through teamwork and group participation
5.2.4 Demonstrate a willingness to compromise
5.2.5 Identify methods for dealing with harassment, bias, and discrimination based on race, color, national origin, gender, religion, disability, or age
5.2.6 Cooperate with authority
5.2.7 Accept supervision

Competency 5.3: Demonstrate accepted social and work behaviors

Competency Builders

5.3.1 Demonstrate a positive attitude
5.3.2 Demonstrate accepted conversation skills
5.3.3 Use good manners
5.3.4 Accept responsibility for assigned tasks
5.3.5 Demonstrate personal hygiene
5.3.6 Demonstrate knowledge of a position
5.3.7 Perform quality work

Competency 5.4: Analyze opportunities for personal and career growth*

Competency Builders:

5.4.1 Determine opportunities within chosen occupation/organization*
5.4.2 Determine other career opportunities outside chosen occupation/ organization*
5.4.3 Evaluate the factors involved in considering a new position within or outside an occupation/ organization*
5.4.4 Exhibit characteristics needed for advancement*

Unit 6: Technology in the Workplace

Competency 6.1: Demonstrate knowledge of technology issues

Competency Builders:

6.1.1 Demonstrate knowledge of the characteristics of technology
6.1.2 Demonstrate knowledge of how technology systems are applied
6.1.3 Assess the impact of technology on the individual, society, and environment
6.1.4 Demonstrate knowledge of the evolution of technology
6.1.5 Identify how people, information, tools and machines, energy, capital, physical space, and time influence the selection and use of technology
6.1.6 Identify legal and ethical issues related to technology (e.g., confidentiality, information sharing, copyright protection)

Competency 6.2: Demonstrate skills related to technology issues

Competency Builders:

6.2.1 Exhibit willingness to adapt to technological change
6.2.2 Utilize technological systems
6.2.3 Utilize a variety of resources and processes to solve technological problems
6.2.4 Employ higher-order thinking skills for solving technological problems
6.2.5 Work as a team member in solving technological problems
6.2.6 Use technology in a safe and responsible manner
6.2.7 Apply science, mathematics, communication, and social studies concepts to solve technological problems
6.2.8 Demonstrate ingenuity and creativity in the use of technology*
6.2.9 Utilize a formal method (systems approach) in solving technological problems*

Unit 7: Lifelong Learning

Competency 7.1: Apply lifelong learning practices to individual situations

Competency Builders:

7.1.1 Define lifelong learning
7.1.2 Identify factors that cause the need for lifelong learning
7.1.3 Identify changes that may require the retraining and upgrading of employee's skills
7.1.4 Identify avenues for lifelong learning
7.1.5 Participate in lifelong learning activities

Competency 7.2: Adapt to change

Competency Builders:

7.2.1 Analyze the causes and effects of change
7.2.2 Identify the effect of change on goals
7.2.3 Identify the importance of flexibility when reevaluating goals
7.2.4 Evaluate the need for lifelong learning experiences in adapting to change

Unit 8: Economic Education

Competency 8.1: Analyze how an economy functions as a whole

Competency Builders:

8.1.1 Describe how individuals and societies make choices to satisfy needs and wants with limited resources
8.1.2 Identify how production factors (land, labor, capital, and entrepreneurship) are used to produce goods and services
8.1.3 Illustrate how individuals and households exchange their resources for the income they use to buy goods and services
8.1.4 Explain how individuals and business firms use resources to produce goods and services to generate income
8.1.5 Identify characteristics of command, market, and traditional economies*
8.1.6 Describe how all levels of government assess taxes in order to provide services

Competency 8.2: Analyze how an economic system is a framework within which decisions are made by individuals and groups

Competency Builders:

8.2.1 List several individuals and groups that make economic decisions at the local, state, and national levels
8.2.2 Identify the important roles that local, state, and national governments play in a market economy

Continued

Competency 8.2: ***Analyze how an economic system is a framework within which decisions are made by individuals and groups—Continued***

8.2.3 List examples of how government decisions affect individuals
8.2.4 Identify how geographic locations affect the political and economic systems of the world
8.2.5 Evaluate how markets allocate goods and services
8.2.6 Explain how resources, goods, and services are exchanged in markets
8.2.7 Explain competition and its effect on the market

Competency 8.3: Analyze the importance of making informed personal financial decisions

Competency Builders:

8.3.1 Describe the need for personal management records
8.3.2 Create a personal budget
8.3.3 Create a budget for a family of four for one month
8.3.4 Explain how credit affects personal/family finances
8.3.5 Identify steps to avoid credit problems
8.3.6 Make informed consumer choices in response to personal needs and wants
8.3.7 Identify factors that influence consumer decisions (e.g., advertisements, peer groups, price, and location)
8.3.8 Explain the costs and benefits for individuals of various types of taxation at the local, state, and federal levels

Unit 9: Balancing Work and Family

Competency 9.1: Analyze the effects of family on work

Competency Builders:

9.1.1 Recognize how family values, goals, and priorities are reflected in the workplace
9.1.2 Identify present and future family structures and responsibilities
9.1.3 Describe personal and family roles
9.1.4 Analyze concerns of working parent(s)
9.1.5 Examine how family responsibilities can conflict with work
9.1.6 Identify ways to resolve family-related conflicts
9.1.7 Explain how to use support systems/community resources to help resolve family-related conflicts

Competency 9.2: Analyze the effects of work on family

Competency Builders:

9.2.1 Identify responsibilities associated with paid and nonpaid work
9.2.2 Compare the advantages and disadvantages of multiple incomes
9.2.3 Explain how work can conflict with family responsibilities
9.2.4 Explain how work-related stress can affect families
9.2.5 Identify family support systems and resources

Unit 10: Citizenship in the Workplace

Competency 10.1: Exercise the rights and responsibilities of citizenship in the workplace

Competency Builders:

10.1.1 Identify the basic rights and responsibilities of citizenship in the workplace
10.1.2 Identify situations in which compromise is necessary
10.1.3 Examine how individuals from various backgrounds contribute to the workplace
10.1.4 Demonstrate initiative to facilitate cooperation
10.1.5 Give/receive constructive criticism to enhance cooperation

Competency 10.2: Prepare to work in a multicultural society

Competency Builders:

10.2.1 Identify ways to live in a multicultural society with mutual respect and appreciation for others
10.2.2 Examine how culture and experience create differences in people
10.2.3 Demonstrate respect for the contributions made by all people
10.2.4 Investigate personal cultural background as a means of developing self-respect
10.2.5 Make personal choices that reduce discrimination, isolation, and prejudice
10.2.6 Work effectively with people irrespective of their race, gender, religion, ethnicity, disability, age, or cultural background

Unit 11: Leadership

Competency 11.1: Evaluate leadership styles appropriate for the workplace

Competency Builders:

11.1.1 Identify characteristics of effective leaders
11.1.2 Compare leadership styles
11.1.3 Demonstrate effective delegation skills
11.1.4 Investigate empowerment concepts
11.1.5 Identify opportunities to lead in the workplace

Competency 11.2: Demonstrate effective teamwork skills

Competency Builders:

11.2.1 Identify the characteristics of a valuable team member
11.2.2 Identify methods of involving each team member
11.2.3 Contribute to team efficiency and success
11.2.4 Determine ways to motivate team members

Competency 11.3: Utilize effective communication skills

Competency Builders:

11.3.1 Identify the importance of listening
11.3.2 Demonstrate effective listening skills
11.3.3 Demonstrate assertive communication techniques
11.3.4 Recognize the importance of verbal and nonverbal cues and messages
11.3.5 Prepare written material
11.3.6 Analyze written material
11.3.7 Give/receive feedback
11.3.8 Communicate thoughts
11.3.9 Use appropriate language
11.3.10 Follow oral and written instructions
11.3.11 Demonstrate effective telephone techniques
11.3.12 Identify technology in communications

Unit 12: Entrepreneurship

Competency 12.1: Evaluate the role of small business

Competency Builders:

12.1.1 Identify the impact of small business on the local economy
12.1.2 Examine the relationship of small business to a national (USA) and global economy
12.1.3 Identify factors that contribute to the success of small business
12.1.4 Identify factors that contribute to the failure of small business
12.1.5 Identify the components of a business plan

Competency 12.2: Examine entrepreneurship as a personal career option

Competency Builders:

12.2.1 Evaluate personal interests and skills
12.2.2 Compare personal interests and skills with those necessary for entrepreneurship
12.2.3 Determine motives for becoming an entrepreneur
12.2.4 Identify the advantages and disadvantages of owning a small business
12.2.5 Compare business ownership to working for others

Notes

Academic Job Profile

The Purpose of Job Profiling

Developed by American College Testing (ACT), the purpose of the Job Profiling process is to identify the **level** of applied academic skills that, according to business and industry, students must master to qualify for and be successful in their occupation of choice. The results of Job Profile "leveling" can help teachers to better target instruction toward their students' needs.

As part of the Ohio Vocational Competency Assessment (OVCA) program, the Vocational Instructional Materials Laboratory (VIML) at The Ohio State University has conducted Job Profiling workshops in which representatives of business, industry, labor, and community organizations identified the academic skill levels needed by entry-level workers in the occupational areas covered by the OCAPs. The Job Profiling, which was carried out in spring 1994 and spring 1995, was sponsored by the Ohio Department of Education, Division of Vocational and Adult Education.

OVCA—What Is It?

The Ohio Vocational Competency Assessment (or OVCA) package consists of two assessment components: OCAP and Work Keys. Together they measure entry-level occupational, academic, and employability skills. All OVCA items are criterion-referenced, use a multiple-choice format, and are administered using a traditional paper-and-pencil method. The OVCA is designed to do the following:

- Provide one dimension of a multi-assessment strategy for career passport credentialing
- Evaluate learner readiness for jobs requiring specific occupational, academic, and employability skills
- Assist educators in curriculum development
- Provide state-aggregated learning gain scores to comply with the regulations in the Carl D. Perkins Vocational and Applied Technology Act of 1990

OCAP. The OCAP component of OVCA assesses students in occupational skills—employment requirements—in a particular occupational area. Assessment is based on the core competencies identified through the OCAP process, and each multiple-choice assessment item is correlated to those essential competencies.

Work Keys. The Work Keys component, developed by ACT, measures students' applied academic skills. All OVCA packages contain two Work Keys assessments:

- *Applied Mathematics* measures students' ability to analyze, set up, and solve math problems typically found in the workplace.
- *Locating Information* measures students' ability to use graphic documents to insert, extract, and apply information.

In addition, certain taxonomies will use the following Work Keys assessments:

- *Reading for Information* will be used by Business, Marketing, Home Economics, Health Education, and Cosmetology taxonomies.
- *Applied Technology* will be used by Trade and Industrial and Agricultural Education taxonomies.

Other optional Work Keys assessments, not included in the basic OVCA package, are *Teamwork*, *Listening*, and *Writing*.

Each Work Keys assessment is further broken down into four to five levels of achievement, with higher numbers indicating higher achievement in the assessed skill (descriptions of the levels for each Work Keys assessment are provided on pp. 43-49). For each academic skill, the Job Profiling process identifies the level required for successful entry into an occupational area.

Job Profiling—How It Works

VIML's Job Profiling process was initiated by mailing surveys to current workers in OCAP occupations all across Ohio. The survey's purpose: to have actual workers in specific occupations rate job tasks according to each task's frequency and criticality—that is, the amount of time spent performing each task relative to other tasks and the importance of each task to overall job performance.

To complete the survey, participants examined OCAP competencies for their occupation. Based on the survey's results, VIML staff produced a list of the most critical competencies in each occupation.

The next stage of Job Profiling was to convene committees of subject-matter experts to perform "leveling," which involved the following tasks:

- Examining the frequency and criticality competency lists for an occupation
- Reviewing the levels associated with each of the seven Work Keys academic skills: *Locating Information, Reading for Information, Applied Mathematics, Applied Technology, Listening, Writing,* and *Teamwork*
- Identifying the level of skill students must master relative to each Work Keys academic skill in order to successfully perform the occupational competencies

Finally, in 1995, the initial leveling of Work Keys academic skills for the occupational area covered by this OCAP was revalidated by the new panel of expert workers convened to update the OCAP (see inside back cover).

Example of Job Profiling

For every occupational area, there are shaded graphs to represent each of the seven Work Keys academic skills. Each graph shows the range of levels for that particular skill; the shading represents the academic skill level required by an entry-level worker in that occupation, as determined by the Job Profiling committee. For example:

Applied Mathematics

In the example shown, Applied Mathematics has a skill range of 3–7. The required skill level, determined by Job Profiling and shown by the highlighting, is 6.

Academic Job Profile: Environmental Management

Applied Mathematics

Locating Information

Reading for Information

Applied Technology

Teamwork

Listening

Writing

NOTE: Definitions of each level in each of the seven academic skill areas are provided on the pages that follow.

Levels of Work Keys Defined

The skills needed to achieve each level for each of the seven Work Keys* academic skills are as follows.

Applied Mathematics

Applied Mathematics measures skill in applying mathematical reasoning to work-related problems. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Perform basic mathematical operations (addition, subtraction, multiplication, and division) and conversions from one form to another, using whole numbers, fractions, decimals, or percentages.
- Translate simple verbal problems into mathematical equations.
- Directly apply logical information provided to solve problems, including those with measurements and dollars and cents.

Level 4

- Perform one or two mathematical operations (such as addition, subtraction, or multiplication) on several positive or negative numbers. (Division of negative numbers is not covered until Level 5.)
- Add commonly known fractions, decimals, or percentages (e.g., ½, .75, 25%) or add three fractions that share a common denominator.
- Calculate averages, simple ratios, proportions, and rates, using whole numbers and decimals.
- Reorder verbal information before performing calculations.
- Read simple charts or graphs to obtain information needed to solve a problem.

Level 5

- Look up and calculate single-step conversions within English or non-English measurement systems (e.g., converting ounces to pounds or centimeters to meters) or between measurement systems (e.g., converting centimeters to inches).
- Make calculations using mixed units (e.g., hours and minutes).
- Determine what information, calculations, and unit conversions are needed to find a solution.

Level 6

- Calculate using negative numbers, fractions, ratios, percentages, mixed numbers, and formulas.
- Identify and correct errors in calculations.
- Translate complex verbal problems into mathematical expressions, using considerable setup and multiple-step calculations or conversions.

Level 7

- Solve problems requiring multiple steps of logic and calculation.
- Solve problems involving more than one unknown, nonlinear functions (e.g., rate of change), and applications of basic statistical concepts (e.g., error of measurement).
- Locate errors in multiple-step calculations.
- Solve problems with unusual content or format, or with incomplete or implicit information.

**Work Keys Score Interpretation Guide.* © 1994 by American College Testing (ACT). Used with permission.

Locating Information

Locating Information measures skill in using information taken from workplace graphics such as diagrams, blueprints, floor plans, tables, forms, graphs, charts, and instrument gauges. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Find one or two pieces of information in elementary workplace graphics, such as simple order forms, bar graphs, tables, flowcharts, and floor plans.
- Fill in one or two pieces of information that are missing from elementary workplace graphics.

Level 4

- Find several pieces of information in straightforward workplace graphics, such as basic order forms, line graphs, tables, instrument gauges, maps, flowcharts, and diagrams.
- Summarize and/or compare information and trends in a single straightforward graphic.
- Summarize and/or compare information and trends among more than one straightforward workplace graphic, such as a bar chart and a data table showing related information.

Level 5

- Summarize and/or compare information and trends in single complicated workplace graphics, such as detailed forms, tables, graphs, maps, instrument gauges, and diagrams.
- Summarize and/or compare information and trends among more than one complicated workplace graphic, such as a bar chart and a data table showing related information.

Level 6

- Make decisions, draw conclusions, and/or apply information to new situations using several related and complex workplace graphics that contain a great amount of information or have challenging presentations (e.g., very detailed graphs, charts, tables, forms, maps, blueprints, diagrams).

Reading for Information

Reading for Information measures skill in reading and understanding work-related reading materials. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. Although Level 3 is the least complex, it still represents a level of reading skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Identify uncomplicated key concepts and simple details.
- Recognize the proper placement of a step in a sequence of events, or the proper time to perform a task.
- Identify the meaning of words that are defined within a passage.
- Identify the meaning of simple words that are not defined within a passage.
- Recognize the application of instructions from a passage to situations that are described in the passage.

Level 4

- Identify details that are more subtle than those in Level 3.
- Recognize the application of more complex instructions, some of which involve several steps, to described situations.
- Recognize cause-effect relationships.

Level 5

- Identify the paraphrased definition of jargon or technical terms that are defined in a passage and recognize the application of jargon or technical terms to stated situations.
- Recognize the definition of acronyms that are defined in a passage.
- Identify the appropriate definition of words with multiple meanings.
- Recognize the application of instructions from a passage to new situations that are similar to the situations described in the reading materials.
- Recognize the applications of more complex instructions to described situations, including conditionals and procedures with multiple steps.

Level 6

- Recognize the application of jargon or technical terms to new situations.
- Recognize the application of complex instructions to new situations.
- Recognize the less-common meaning of a word with multiple meanings from context.
- Generalize from a passage to situations not described in the passage.
- Identify implied details.
- Explain the rationale behind a procedure, policy, or communication.
- Generalize from a passage to a somewhat similar situation.

Level 7

- Recognize the definitions of difficult, uncommon jargon or technical terms from context.
- Generalize from a passage to situations neither described in nor completely similar to those in a passage.

Applied Technology

Applied Technology measures skill in solving problems of a technological nature, involving the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics as they apply to machines and equipment found in the workplace. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of applied technology skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Apply the elementary physical principles underlying the operation of uncomplicated systems or tools.
- Recognize and identify relevant aspects of simple problems that involve one uncomplicated system or tool.
- Select appropriate methods or materials needed to solve problems.

Level 4

- Recognize, identify, and order relevant aspects of one moderately complex system or more than one uncomplicated system.
- Evaluate alternative solutions to determine the most appropriate one for the situation presented.

Level 5

- Solve problems based on one complex system, or one or more uncomplicated tools or systems.
- Understand and apply moderately difficult principles of mechanics, electricity, thermodynamics, and fluid dynamics, in addition to understanding complex machines and systems.
- Recognize, identify, and order relevant aspects of a problem before reaching an appropriate solution.

Level 6

- Solve problems that do not contain all the information needed to solve them, and/or in which the information provided may be out of logical order.
- Solve problems that contain extraneous information.
- Solve problems involving one or more tools or systems having a wide range of complexity.
- Apply difficult physical principles.
- Understand and correctly interpret the interaction of several complex systems.

Listening

Listening measures skill in listening to and understanding work-related messages; receiving information from customers, coworkers, or suppliers; and then writing down the information to communicate it to someone else. Students demonstrate their ability to distinguish and communicate critical information and noncritical information. **Critical information** consists of those details that the recipient of the message must have in order to understand the message and act upon it (e.g., names, phone numbers, addresses, times). **Noncritical information** can improve a message by providing details that further explain the message or its tone, but the absence of this noncritical information does not interfere with the recipient's ability to understand and accurately act upon the message. Each *Listening* level describes the **content and quality** of messages students write to describe an audio message.

Level 0

- No meaningful information, or totally inaccurate information.

Level 1

- Minimal pertinent information; enough context to provide clues as to gist of situation or source of further information.

Level 2

- Some pertinent information; may have incorrect critical information, but sketch of the situation is correct.

Level 3

- All the critical information that is present is correct; may be missing a few pieces of critical information.

Level 4

- All critical information is given and is correct; may be missing subtle details or tone; may have incorrect noncritical information that does not interfere with central meaning.

Level 5

- All critical information is present and correct; response conveys insight into situation through tone and/or subtle details.

Writing

Writing measures skill at writing work-related messages; receiving information from customers, co-workers, or suppliers; and then writing down the information to communicate it to someone else. Each *Writing* level rates the **writing mechanics** (such as sentence structure and grammar) **and writing style** of messages students write to describe an audio message.

Level 0

- An attempt is made at the message, but the message is completely garbled with no recognizable sentence structure.

Level 1

- Message conveyed inadequately; overall lack of proper sentence structure.

Level 2

- Message conveyed inadequately; weak sentence structure; large number of mechanical errors.

Level 3

- Message conveyed clearly; most sentences complete; some mechanical errors.

Level 4

- Message conveyed clearly; all sentences are complete; may have a few minor mechanical errors; may have a choppy style.

Level 5

- Message conveyed clearly; good sentence structure; no mechanical errors; highly appropriate for business setting and situation; smooth, logical style.

Teamwork

Teamwork measures skill in choosing behaviors and/or actions that simultaneously support team interrelationships and lead toward the accomplishment of work tasks. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of teamwork skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Identify team goals and ways to work with other team members to accomplish those goals.
- Choose actions that support the ideas of other team members to accomplish team goals.
- Recognize that a team is having problems finishing a task and identify the cause of those problems.

Level 4

- Identify the organization of tasks and the time schedule that would help accomplish team goals efficiently and effectively.
- Select approaches that accept direction from other team members in order to accomplish tasks and to build and keep up good team relations.
- Identify behaviors that show appreciation for the personal and professional qualities of other team members and respect for their diversity.

Level 5

- Identify courses of action that give direction to other team members effectively.
- Choose approaches that encourage and support the efforts of other team members to further team relationships and/or task accomplishment.
- Consider the possible effects of alternative behaviors on both team relationships and team accomplishments and select the one that would best help the team meet its goals.

Level 6

- Identify the focus of team activity and select a new focus if that would help the team meet its goals more effectively.
- Select approaches that show the willingness to give and take direction as needed to further team goals (e.g., recognize the organization of team members' tasks that would best serve the larger goals of the team).
- Choose approaches that encourage a team to act as a unit and reach agreement when discussing specific issues.
- Identify actions that would help manage differences of opinion among team members, moving the team toward its goals while valuing and supporting individual diversity.

Notes

Academic Competencies

Total List of Academic Competencies

Three products of the Ohio Department of Education, Division of Curriculum, Instruction, and Professional Development, describe the academic skills that should be possessed by each student at the end of each grade level:

- *Model Competency-Based Language Arts Program*
- *Model Competency-Based Mathematics Program*
- *Model Competency-Based Science Program*

The following lists were derived from the academic competencies delineated for Grades 9-12 in these documents. Although the competencies are listed separately by grade level in the original documents, the levels were combined—and in some cases refined—for OCAP purposes, any overlap was eliminated, and a numbering system was imposed for ease of reference.

During the course of the OCAP workshops, each of the representatives from business, industry, labor, and community-based organizations was given a copy of these lists of academic competencies and instructed to circle the competencies that an entry-level employee should possess. The results from each panel were tallied to identify those required academic competencies most crucial to entry level in each specific occupational area. The results for this OCAP are presented on pp. 67-76.

Unit: Communications Skills

Subunit: Reading—Structure

Competencies:

RS1 Exhibit knowledge of language structure
RS2 Recognize that there may be more than one interpretation of reading selections
RS3 Recognize various literary devices (e.g., metaphor, simile, personification, hyperbole, pun, alliteration)
RS4 Recognize and discuss literary elements (e.g., plot, dialogue, theme, setting, characterization)
RS5 Develop and use an increasingly sophisticated vocabulary gained through context
RS6 Apply knowledge of language structure to reading
RS7 Explain why there may be more than one interpretation of reading selections
RS8 Recognize effect of literary devices on meaning
RS9 Analyze author's use of literary elements
RS10 Recognize relationship of structure to meaning
RS11 Describe various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS12 Characterize author's use of literary devices
RS13 Characterize use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS14 Critique a variety of literature with regard to plot, dialogue, theme, setting, and characterization
RS15 Apply an expanding vocabulary gained through reading
RS16 Explain various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS17 Analyze use of literary devices (e.g., extended metaphor, simile, personification, hyperbole, pun, alliteration)
RS18 Understand use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS19 Analyze and synthesize pieces of literature with regard to plot, dialogue, theme, setting, and characterization

Subunit: Reading—Meaning Construction

Competencies:

- RM1 Demonstrate ability to recognize appropriate pre-reading strategies
- RM2 Describe effectiveness of a reading selection
- RM3 Read to clarify personal thinking and knowledge
- RM4 Support interpretation of text by locating and citing specific information
- RM5 Develop personal response to a variety of literary works
- RM6 Recognize diverse literary interpretations
- RM7 Engage in self-selected reading activities
- RM8 Confirm and extend meaning in reading by researching new concepts and facts
- RM9 Self-monitor and apply corrective strategies when communication has been interrupted or lost
- RM10 Use features of literary genres to extend meaning
- RM11 Assess effectiveness of a selection read
- RM12 Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
- RM13 Use knowledge of semantic elements (e.g., figurative language, denotation, connotation, dialect) to clarify meaning when reading
- RM14 Predict, recognize, interpret, and analyze themes based on familiarity with author's work
- RM15 Compare and contrast literary genres
- RM16 Assess validity and quality of selection read (e.g., predict, summarize, analyze, infer)
- RM17 Clarify meaning when reading, using knowledge of literary devices, stylistic diction, and other semantic elements
- RM18 Compare personal reaction to critical assessment of a literary selection
- RM19 Assess validity of diverse literary interpretations
- RM20 Use reference books to find, evaluate, and synthesize information
- RM21 Identify tone of a literary work (e.g., ironic, serious, conversational, humorous)
- RM22 Critique validity of diverse literary interpretations
- RM23 Integrate personal reaction to and critical assessment of a literary selection

Subunit: Reading—Application

Competencies:

- RA1 Select and read material for personal enjoyment and information
- RA2 Read a variety of complete, unabridged works (e.g., self-selected or assigned stories, essays, nonfiction, plays, novels, poetry)
- RA3 Employ various reading strategies (e.g., scanning, skimming, reviewing, questioning, testing, retaining) according to purpose
- RA4 Participate in selection of books, materials, and topics for literature study groups
- RA5 Develop and apply knowledge of the interrelationship of concepts (e.g., construction of webs, graphs, timelines)
- RA6 Read selections from a variety of styles and formats, recognizing that style and format influence meaning
- RA7 Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities
- RA8 Read extensively from the works of a particular author, and explain elements of author's style

Subunit: Reading—Multidisciplinary

Competencies:

- RM1 Connect themes and ideas across disciplines through literature
- RM2 Read to facilitate learning across curriculum
- RM3 Read to develop awareness of human rights and freedom
- RM4 Participate actively in a community of learners

RM5 Recognize and explain interaction between literature and various cultural domains (e.g., social, technological, political, economic)
RM6 Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures by reading and experiencing our diverse literary tradition, including works by men and women of many racial, ethnic, and cultural groups
RM7 Value thinking and language of others
RM8 Relate literature to historical period about which or in which it was written
RM9 Read to facilitate content learning

Subunit: Writing—Structure

Competencies:

WS1 Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through practice and discussion
WS2 Clarify word choice according to audience, topic, and purpose
WS3 Locate and correct errors in usage, spelling, and mechanics (e.g., subject-verb agreement, parallel construction, pronoun reference, punctuation, capitalization, sentence structure) using a variety of resources
WS4 Recognize information gained from primary and secondary sources
WS5 Develop writing that contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS6 Use information from a variety of sources to develop an integrated piece of writing
WS7 Evaluate and revise writing to focus on such things as audience, tone, and purpose
WS8 Recognize differences between documentation and reference list styles
WS9 Develop extended pieces of writing that contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS10 Select from a repertoire of organization strategies a pattern appropriate to a topic (e.g., narration, example, detail, comparison/contrast, classification)
WS11 Synthesize information from a variety of sources to construct meaning
WS12 Refine word choice and tone according to audience, situation, and purpose
WS13 Appropriately cite information gained from primary and secondary sources
WS14 Use style manuals or software to prepare documentation and reference lists
WS15 Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas
WS16 Identify organization patterns appropriate to writing topic
WS17 Respond to others' suggested revisions to a writing piece

Subunit: Writing—Meaning Construction

Competencies:

WM1 Demonstrate knowledge of the recursive nature of the writing process by applying it appropriately to various topics, situations, and audiences (e.g., making connections between prior knowledge and new information, consulting other sources)
WM2 Develop criteria for writing evaluation using scoring guides (e.g., rubric/holistic scale, primary trait scoring) and peer/teacher assistance to clarify meaning
WM3 Respond to others' suggested revisions to a piece of writing (e.g., self-question, re-read, revise)
WM4 Use word processing, graphics, and publishing as aids for constructing meaning in writing
WM5 Engage in self-initiated writing activities
WM6 Incorporate personal criteria with generally accepted standards for writing evaluation
WM7 Evaluate, analyze, and synthesize information for writing
WM8 Evaluate own writing using personal and established scoring criteria
WM9 Assess personal/peer revisions to a writing piece
WM10 Recognize and refine personal writing styles

Subunit: Writing—Application

Competencies:

- WA1 Apply appropriate writing techniques (e.g., prewriting, drafting, revising, editing, presenting) suitable for varied writing tasks
- WA2 Use sentence-combining techniques to improve syntactic fluency and maturity
- WA3 Write in response to prompted and self-selected topics in practical, persuasive, descriptive, narrative, and expository domains
- WA4 Develop personal voice in writing
- WA5 Consider audience and purpose for writing
- WA6 Develop criteria for selection and potential development of topic
- WA7 Write in a journal or learning log to clarify personal thinking and knowledge
- WA8 Apply an expanding vocabulary gained through writing
- WA9 Make judicious use of reference sources (e.g., dictionary, thesaurus, online database, encyclopedia)
- WA10 Demonstrate an appreciation for aesthetically pleasing language through word choice and style
- WA11 Apply revising and editing strategies needed for writing task
- WA12 Vary sentence lengths and patterns
- WA13 Refine personal voice in writing
- WA14 Vary styles and formats for intended purpose and audience
- WA15 Apply criteria for selection and development of topic
- WA16 Participate in peer review of writing in progress
- WA17 Use transitions between sentences, ideas, and paragraphs in writing
- WA18 Revise and edit papers extensively in preparation for presentation/publication
- WA19 Develop a variety of genres (e.g. fantasy, science fiction, short stories, poetry)
- WA20 Focus writing and tone on such elements as audience, situation, and purpose
- WA21 Develop topic fully and appropriately
- WA22 Use writing process to clarify personal thinking and knowledge
- WA23 Apply appropriate recursive writing process as suggested by writing task and writer's process
- WA24 Develop an extended piece of writing (e.g., story, narrative poem, autobiography, novel, research paper)
- WA25 Revise writing and tone to assure focus on such elements as audience, situation, and purpose
- WA26 Use writing process to write reflectively

Subunit: Writing—Multidisciplinary

Competencies:

- WM1 Use writing process for learning across curriculum
- WM2 Use writing process to demonstrate knowledge of need for human rights and freedom
- WM3 Value and apply collaborative skills in the writing process
- WM4 Write in response to reading, speaking, viewing, and listening
- WM5 Use multidisciplinary resources in writing projects
- WM6 Use writing process to facilitate learning across curriculum
- WM7 Recognize value of and engage in collaboration in the writing process
- WM8 Use communication processes to develop a published writing piece in collaboration with others
- WM9 Record experiences and observations related to content learning
- WM10 Apply collaborative skills in the writing process
- WM11 Write collaboratively with peers
- WM12 Use cross-disciplinary resources in writing projects

Subunit: Listening/Visual Literacy—Structure

Competencies:

- LS1 Listen to and view a wide variety of genres (e.g. mystery, drama, poetry)
- LS2 Become aware of an author's style through listening to and viewing a variety of works

LS3 Recognize correct and appropriate grammar, diction, and syntax
LS4 Expand vocabulary through listening to and viewing varied media (e.g., recordings, films, music, news broadcasts)
LS5 Recognize beauty of language
LS6 Enhance recognition of an author's style through listening to and viewing a variety of works
LS7 Recognize use and misuse of language in media
LS8 Refine knowledge of style through listening to and viewing multiple works by the same author
LS9 Expand and refine grammar, diction, and syntax through listening
LS10 Compare authors' styles through viewing and listening to their works
LS11 Expand knowledge of complex grammar, diction, and syntax issues

Subunit: Listening/Visual Literacy—Meaning Construction

Competencies:

LM1 Develop critical thinking skills necessary to evaluate media and assess oral presentations
LM2 Compare new oral texts to past experiences and knowledge in order to enhance comprehension
LM3 Recognize how rhythmic patterns, silence, and cadences enhance quality of speech and literature
LM4 Focus listening and viewing on themes and/or plots
LM5 Gather information from listening and viewing experiences to enhance research
LM6 Use critical thinking skills to evaluate media and oral presentations
LM7 Use prior knowledge and experiences to facilitate comprehension of new oral texts
LM8 Identify rhythmic and time patterns in speech and literature
LM9 Identify and analyze themes and/or plots when listening and viewing
LM10 Use information gathered from listening and viewing experiences to expand research
LM11 Enhance use of critical thinking skills to evaluate media and oral presentations
LM12 Consider prior knowledge and experiences when attempting to understand the meaning of new texts
LM13 Appreciate rhythmic and time patterns of speech and literature
LM14 Select viewing and listening materials to support written text
LM15 Evaluate media and oral presentations analytically and critically
LM16 Organize prior knowledge and experiences to comprehend new texts
LM17 Organize and use viewing and listening materials to support written text

Subunit: Listening/Visual Literacy—Application

Competencies:

LA1 Listen attentively during oral reading
LA2 Use media as stimuli for learning and thinking
LA3 Develop knowledge of structure through art, music, and literature
LA4 Use electronic media to enhance and highlight language learning
LA5 Listen and view for entertainment and enjoyment
LA6 Use technology and other media (e.g., videos, posters, maps, graphs, t-shirts) as means of expressing ideas

Subunit: Listening/Visual Literacy—Multidisciplinary

Competencies:

LM1 Facilitate learning across curriculum through critical listening and viewing
LM2 Engage in individual, small-group, and whole-group listening and viewing activities
LM3 Develop language arts (e.g., viewing, listening) projects collaboratively
LM4 Investigate language and cultural differences through listening and viewing activities
LM5 Participate in a community of learners through productive listening

Subunit: Oral Communication—Structure

Competencies:

- OS1 Refine oral communication skills (e.g., voice modulation, eye contact, body language)
- OS2 Demonstrate knowledge of grammar, usage, and syntax when presenting
- OS3 Select topics and vocabulary suitable to audience
- OS4 Organize notes and ideas for speaking (e.g., cause-effect, chronological, exemplification)
- OS5 Use language imaginatively (e.g., word games, puns, limericks)
- OS6 Modulate voice to enhance meaning when interpreting literature orally
- OS7 Organize notes and ideas for formal, semiformal, and informal presentations of information
- OS8 Refine speaking techniques for formal, semiformal, and informal settings
- OS9 Develop repertoire of organizational strategies for presenting information orally
- OS10 Expand vocabulary to fit topic
- OS11 Select topics suitable to audience, situation, and purpose
- OS12 Select appropriate strategies when organizing notes and ideas for speaking

Subunit: Oral Communications—Meaning Construction

Competencies:

- OM1 Make connections between prior knowledge and new information for oral presentations
- OM2 Participate in informal speaking activities (e.g., offering opinions, supporting statements, questions, clarification, entertainment)
- OM3 Use interviewing techniques to gather information
- OM4 Communicate orally to entertain and to inform
- OM5 Participate in group communication activities (e.g., debates, panel discussions, negotiations, book-sharing, roundtables, cooperative/collaborative groups)
- OM6 Take and organize notes when preparing speech/presentation
- OM7 Interpret texts orally to illustrate meaning
- OM8 Respond to needs of various audiences
- OM9 Gather and assess information for speaking
- OM10 Communicate orally to inform and persuade
- OM11 Prepare and deliver formal speech/presentation
- OM12 Participate in a variety of oral interpretations
- OM13 Assess needs of audience, and adjust language and presentation according to their knowledge
- OM14 Analyze and synthesize information for speaking
- OM15 Describe effectiveness of a literary selection
- OM16 Describe topic or idea in order to clarify personal/audience thinking
- OM17 Analyze and synthesize information gathered from a variety of sources (e.g., interviews, hypermedia, reference works) for speaking
- OM18 Describe validity and/or quality of a literary selection and justify selection
- OM19 Interpret orally a variety of literature
- OM20 Describe topic or idea to clarify meaning for others

Subunit: Oral Communication—Application

Competencies:

- OA1 Become proficient at using interviewing techniques
- OA2 Give an oral interpretation for a specific audience
- OA3 Develop and apply oral communication skills for cooperative/collaborative learning
- OA4 Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
- OA5 Develop and apply decision-making strategies
- OA6 Practice interviewing techniques
- OA7 Apply interviewing techniques to purposeful interviews
- OA8 Focus oral interpretation on a specific audience

Subunit: Oral Communications—Multidisciplinary

Competencies:

- OM1 Value thinking and language of others
- OM2 Develop oral projects collaboratively
- OM3 Be involved in individual, small-group, and whole-group language activities
- OM4 Participate actively in a community of learners
- OM5 Investigate language and cultural differences through oral language activities

Unit: Mathematics Skills

Subunit: Numbers and Number Relations

Competencies:

- NR1 Compare, order, and determine equivalence of real numbers
- NR2 Estimate answers, compute, and solve problems involving real numbers
- NR3 Compare and contrast real number system, rational number system, and whole number system
- NR4 Extend knowledge to complex number system, and develop facility with its operation

Subunit: Measurement

Competencies:

- M1 Estimate and use measurements
- M2 Understand the need for measurement and the probability that any measurement is accurate to some designated specification
- M3 Understand and apply measurements related to power and work
- M4 Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
- M5 Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
- M6 Use real-world problem situations involving mass and weight
- M7 Use real-world problem situations involving simple harmonic motion
- M8 Establish ratios with and without common units
- M9 Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics
- M10 Understand and solve rate-change problems
- M11 Understand and solve right triangle relationships as they relate to measurement—specifically those that deal with the Pythagorean theorem
- M12 Graph and interpret ordered pairs
- M13 Compute total sales from a variety of items
- M14 Comprehend and compute rates of growth or decay
- M15 Comprehend, compute, and interpret real problems involving annuities
- M16 Develop an ability to identify real problems and provide possible solutions
- M17 Express and apply different types of measurement scales
- M18 Determine area and volume

NOTE: The math subunit on problem solving was not included on this list since it should be a continuing thread throughout all instruction rather than a separate set of competencies.

Subunit: Estimation and Mental Computation

Competencies:

- E1 Use estimation to eliminate choices in multiple-choice tests
- E2 Use estimation to determine reasonableness of problem situations in a wide variety of applications
- E3 Estimate shape of graphs of various functions and algebraic expressions
- E4 Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability

Competencies:

- D1 Organize data into tables, charts, and graphs
- D2 Understand and apply measures of central tendency, variability, and correlation
- D3 Use curve fitting to predict from data
- D4 Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty
- D5 Use computer simulations and random number generators to estimate probabilities
- D6 Test hypotheses using appropriate statistics
- D7 Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions
- D8 Identify probabilities of events involving unbiased objects
- D9 Use sampling and recognize its role in statistical claims
- D10 Design a statistical experiment to study problem, conduct experiment, and interpret and communicate outcomes
- D11 Describe normal curve in general terms, and use its properties
- D12 Create and interpret discrete probability distributions
- D13 Understand concept of random variable
- D14 Apply concept of random variable to generate and interpret probability distributions, including binomial, uniform, normal, and chi square

Subunit: Algebra

Competencies:

- A1 Describe problem situations by using and relating numerical, symbolic, and graphical representations
- A2 Use language and notation of functions in symbolic and graphing settings
- A3 Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solution of an equation in terms of graphical and symbolic representations
- A4 Describe and use logic of equivalence in working with equations, inequalities, and functions
- A5 Develop graphical techniques of solution for problem situations involving functions
- A6 Explore and describe characterizing features of functions
- A7 Make arguments and proofs in algebraic settings
- A8 Factor difference of two squares
- A9 Determine slope, midpoint, and distance
- A10 Explore and combine rational functions
- A11 Explore factoring techniques
- A12 Solve quadratic equations by factoring and formula
- A13 Set up and solve linear equations
- A14 Solve systems of linear equations with two variables
- A15 Describe geometric situations and phenomena using variables, equations, and functions
- A16 Describe measures of central tendency, mean, median, mode, and variance algebraically and graphically
- A17 Represent inequalities on the number line and in the coordinate plane
- A18 Use coordinate arguments in making geometric proofs

A19 Symbolize transformations of figures and graphs
A20 Explore geometric basis for functions of trigonometry
A21 Graph linear functions
A22 Develop and use vectors to represent direction and magnitude, including operations
A23 Use polar and parametric equations to describe, graph, and solve problem situations
A24 Represent sequences and series as functions both algebraically and graphically
A25 Explore recursive functions and procedures using spreadsheets, other computer utilities, and notions appropriate to these problem situations
A26 Describe and solve algebraic situations with matrices
A27 Describe and use inverse relationship between functions, including exponential and logarithmic
A28 Analyze and describe errors (and their sources) that can be made when using computers and calculators to solve problems
A29 Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques
A30 Explore relationships between complex numbers and vectors
A31 Make arguments concerning limits, convergence and divergence in contexts involving sequences, series, and other types of functions
A32 Represent transformations in the plane with matrices
A33 Contrast and compare algebras of rational, real, and complex numbers with characteristics of a matrix algebra system
A34 Construct polynomial approximations of a function over specified intervals of convergence
A35 Examine complex numbers as zeros of functions
A36 Translate verbal statements into symbolic language
A37 Simplify algebraic expressions
A38 Use laws and exponents (including scientific notation)
A39 Expand and extend idea of vectors and linear algebra to higher dimensional situations
A40 Use the idea of independent basis elements for a vector space and associated fundamental concepts of finite dimensional linear algebra
A41 Develop and communicate arguments about limit situations
A42 Use matrices to describe and apply transformations
A43 Develop and use polar and parametric equations to represent problem situations
A44 Explore proofs by mathematical induction

Subunit: Geometry

Competencies:

G1 Create and interpret drawings of three-dimensional objects
G2 Represent problem situations with geometric models and apply properties of figures
G3 Apply Pythagorean theorem
G4 Demonstrate knowledge of angles and parallel and perpendicular lines
G5 Explore inductive and deductive reasoning through applications to various subject areas
G6 Translate between synthetic and coordinate representations
G7 Identify congruent and similar figures using transformation with computer programs
G8 Deduce properties of figures using transformations and coordinates
G9 Use deductive reasoning
G10 Explore compass and straightedge constructions in context of geometric theorems
G11 Demonstrate knowledge of and ability to use proof
G12 Use variety of proof techniques (e.g., synthetic, transformational, and coordinate)
G13 Use variety of proof formats, including T-proof (i.e., two-column) and paragraph proof
G14 Explore different proof strategies
G15 Investigate different proofs of theorems
G16 Develop knowledge of an axiomatic system
G17 Apply transformations and coordinates in problem solving
G18 Represent problem situations with geometric models, and apply properties of figures

G19 Deduce properties of figures using vectors
G20 Analyze properties of Euclidean transformations, and relate translations to vectors
G21 Apply vectors in problem solving
G22 Develop further knowledge of axiomatic systems by investigating and comparing various geometries

Subunit: Patterns, Relations, and Functions

Competencies:

P1 Model real-world phenomena with polynomial and exponential functions
P2 Explore relationship between zeros and intercepts of functions
P3 Translate among tables, algebraic expressions, and graphs of functions
P4 Use graphing calculator or computer to generate graph of a function
P5 Explore relationship between a linear function and its inverse
P6 Describe and use characteristics of polynomial functions in problem-solving situations
P7 Explore conic sections, and graph using graphing calculator or computer
P8 Apply trigonometric functions to problem situations involving triangles
P9 Discover general relationships between algebraic description of conic, kind of conic, and special properties of that conic
P10 Explore periodic real-world phenomena using sine and cosine functions
P11 Analyze effects of parameter changes on graphs
P12 Use graphing calculator or computer to graph functions
P13 Develop a knowledge of rational and transcendental functions
P14 Understand connections between trigonometric and circular functions
P15 Use circular functions to model periodic real-world functions
P16 Solve trigonometric equations, and verify trigonometric identities
P17 Understand connections between trigonometric functions and polar coordinates, exponential functions , logarithmic functions, complex numbers, and series
P18 Model real-world phenomena with a variety of functions
P19 Graph using polar coordinates
P20 Explore graphs in three dimensions
P21 Explore functions of several variables
P22 Explore recursive functions using spreadsheets and/or programming languages

Unit: Science Skills

Subunit: Scientific Inquiry

Competencies:

Q1 Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2 Use ratios, proportions, and probabilities in appropriate problem situations
Q3 Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q4 Use existing algebraic formulas and create new ones in appropriate problem-solving situations
Q5 Estimate and justify probabilities of outcomes of familiar situations based on experimentation and other strategies
Q6 Invent apparatus and mechanical tools needed to perform unique tasks in various situations
Q7 Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
Q8 Design investigations that are safe and ethical (i.e., obtain consent and inform others of potential outcomes, risks, and benefits; and show evidence of concern for the health and safety of humans and non-human species)

Q9 Make and read scale drawings, maps, models, and other representations to aid planning and understanding

Q10 Seek elaboration and justification of data and ideas, and reflect on alternative interpretations of the information

Q11 Use appropriate units for counts and measures

Q12 Create and use databases (electronic and other) to collect, organize, and verify data and observations

Q13 Design and conduct investigations with multiple variables

Q14 Communicate the results of investigations clearly in a variety of situations

Q15 Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations

Q16 Trace the development (e.g., history, controversy, and ramifications) of various theories, focusing on supporting evidence and modification with new evidence

Q17 Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements

Q18 Observe and document events and characteristics of complex systems

Q19 Explain the influence of perspective (e.g., spatial, temporal, and social) on observation and subsequent interpretations

Q20 Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques

Q21 Generate testable hypotheses for observations of complex systems and interactions

Q22 Document potentially hazardous conditions and associated risks in selected homes and public areas

Q23 Participate in public debates, relying on documented and verified data to construct and represent a position on scientific issues

Q24 Construct and test models of physical, biological, social, and geological systems

Q25 Read, verify, debate, and, where necessary, refute research published in popular or technical journals of science (e.g., *Discover, Omni, Popular Mechanics*)

Q26 Explore discrepant events and develop and test explanations of what was observed

Q27 Conduct theory-based research using surveys, observational instruments, and other methods

Q28 Modify personal opinions, interpretations, explanations, and conclusions based on new information

Q29 Analyze error and develop explanations in various domains

Q30 Formulate taxonomic schemes based upon multivariate models that help to explain similarities and differences in form, distribution, behavior, survival, and origin of objects and organisms

Q31 Demonstrate various logical connections between related concepts (e.g., entropy, conservation of energy)

Q32 Account for discrepancies between theories and observations

Q33 Analyze the changes within a system when inputs, outputs, and interactions are altered

Q34 Create, standardize, and document procedures

Q35 Determine the sources of significant disparities between the predicted and recorded results, and change research procedures to minimize disparities

Q36 Research, locate, and propose applications for abstract patterns (e.g., fractals, Fibonacci sequences, string theory, orbitals)

Q37 Recognize and utilize classification systems for particles, elements, compounds, phenomena, organisms, and others for exploring and predicting properties and behaviors

Q38 Suggest and defend alternative experimental designs and data explanations (e.g., sampling, controls, safeguards)

Q39 Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing

Q40 Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories

Q41 Suggest new questions as a result of reflection on and discussions about own scientific investigations

Q42 Investigate, assess, and comment on strengths and weakness of the descriptive and predictive powers of science

Q43 Create new information from representations of data in a variety of forms (e.g., symbols, descriptive languages, graphic formats) utilizing a variety of techniques (e.g., interpolations, extrapolations, linear regressions, central tendencies, correlations)

Subunit: Scientific Knowledge

Competencies:

K1	Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
K2	Investigate the relationship between the rates of energy exchange and the relative energy level of components within systems (e.g., trophic levels of ecosystems, osmosis, rate of heating and cooling, storms)
K3	Investigate patterns in the natural world (e.g., heredity, crystalline structures, population and resource distributions, diffraction, dispersion, polarization)
K4	Investigate models and theories that help to explain the interactions of components in systems (e.g., conservation of mass, energy, and momentum; foodwebs; natural selection; entropy; plate tectonics; chaos; relativity; social-psychology)
K5	Investigate degrees of kinship among organisms and groups of organisms
K6	Investigate the limits of the definition of life, and investigate organisms and physical systems that exist at or near these limits (e.g. viruses, quarks, black holes)
K7	Investigate estimates and measurements of a wide range of distances and rates of change
K8	Investigate the historical development of theories of change over time (e.g., natural selection, continental drift, the big bang, geologic change)
K9	Investigate physical and chemical changes in living and nonliving systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
K10	Investigate simulations of nuclear change (e.g., radioactivity, half life, carbon dating)
K11	Investigate conservation principles associated with physical, chemical, and nuclear changes
K12	Formulate descriptions of the impacts of various forms of mechanical and electromagnetic waves on various organisms and objects
K13	Formulate models and hypotheses for patterns in the natural world (e.g., earth structures, transportation systems, migrations, communications, constellations)
K14	Formulate explanations for the influences of objects and organisms on each other over time
K15	Formulate and interpret explanations for change phenomena (e.g., mass extinctions, stellar evolution, punctuated equilibrium, molecular synthesis)
K16	Formulate and interpret explanations for the magnitudes of diversity at different periods of geologic time (e.g., mutation, global cataclysms, continental drift, competition, mass extinctions)
K17	Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., DNA and RNA variants, nucleons, interaction particles)
K18	Formulate understandings of geologic time (e.g., millennia, periods, epochs)
K19	Formulate an understanding of the historical development of the model of the universe (e.g., Aristotle, Ptolemy, Copernicus, Brahe, Kepler, Galileo, Newton, Einstein)
K20	Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration)
K21	Formulate models and hypotheses about patterns in the natural world (e.g., social behavior, molecular structure, energy transformation, entropy, randomness, aging, chaos, hormonal cycles)
K22	Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems
K23a	Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical)
K23b	Formulate explanations for the historical development of descriptions of motions interactions and transformations of matter and energy (e.g., classical Newtonian mechanics, special and general relativity, chaos)
K24	Formulate models that can be used to describe fundamental molecular interactions in living and non-living systems (e.g., cell membranes, semiconductors).
K25	Formulate an understanding of the degree of relationship among organisms and objects based on molecular structure (e.g., proteins, nucleic acids)
K26	Formulate hypotheses and models that may account for observable events (e.g., electricity and magnetism, gravitation, atoms, bonding, chemical reactions, quantum effects, energy flow on biological systems, predator-prey relationships)

K27 Formulate models and hypotheses about change over time (e.g., natural selection, speciation, punctuated equilibrium, phyleytic gradualism, stellar evolution, plate tectonics, radioactive decay, quantum mechanical theory)

K28 Formulate lists of limitations, and propose refinements of standard classification systems (e.g., periodic table, IUPAC, Linnean, standard model)

K29 Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg uncertainty principle, meteorological prediction, local variation and diversity, earthquake prediction, energy transport in cellular respiration)

K30 Formulate plans and contingencies that can be used to accommodate for changes to and stresses on systems (e.g., wildlife and habitat management, corrosion prevention, noise abatement, structure design)

K31 Formulate models of molecular, atomic, ionic, and subatomic structures and the physical and biological implications of these structures (e.g., genes, nucleons, quarks)

K32 Formulate estimates for a wide range of measurements and scales (e.g., angstroms to light years)

K33 Formulate and interpret representations of time from origin to present accounting for phenomena of scale (e.g., smoothness, punctuations, chaos)

K34 Formulate interpretations of the historical development of various theories of possible causes of diversity among physical and biological phenomena (e.g., the works of Aristotle, Mendel, Darwin, McClintock)

K35 Formulate models and hypotheses that can be used to explain the interactions of components within technological and ecological systems

Subunit: Conditions for Learning Science

Competencies:

C1 Participate actively in dialogue about and resolution of community issues

C2 Assess information from various countries in the original language or translated form to ascertain the perspectives of many cultures

C3 Analyze the scientific ideas presented in science fiction stories and films

C4 Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error

C5 Present the results of investigations in a variety of forums

C6 Contribute to the decisions regarding topics for investigation

C7 Use various creative means to communicate interpretations of scientific ideas, concepts, phenomena, and events

C8 Consider the scientific thinking and language of others

C9 Individually and collaboratively produce clearly written representations of investigative results

C10 Fulfill responsibilities as part of a research group

C11 Select and utilize resources by various criteria (e.g., efficiency, effectiveness, health, safety) that are appropriate to the investigations being conducted by groups

C12 Present persuasive argument based on the scientific aspects of controversial issues

C13 Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications

C14 Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics)

C15 Keep journals of observations and inferences made over an extended period of time, and reflect upon the impact of these recorded ideas on own thinking and actions

C16 Examine the intellect, perspectives, and ethics of notable scientists

C17 Collect and analyze observations made over extended periods of time and compare these to scientific theories

C18 Create presentations of scientific understandings using diverse modes of expressions

C19 Conduct formal scientific debates in the classroom

C20 Wonder about the likelihood of events that may occur by chance or coincidence
C21 Plan and conduct field trips and experiences for small and large groups
C22 Analyze the historical context that leads to and has led to scientific theories
C23 Seek information on topics of personal scientific interest from a variety of sources
C24 Conduct learner-developed investigations independently and collaboratively over periods of weeks and months
C25 Listen attentively and critically to presentations of scientific information made by others
C26 Conduct analyses of propaganda related to scientific issues
C27 Perform investigations that require observations over varying periods of time
C28 Experience scientific concepts as interpreted by other cultures through multimedia and local and global specialists
C29 Access appropriate technology to perform complicated, time-consuming tasks
C30 Relate historical accounts of science to the cultural context in which they were written
C31 Work as a contributing member of a collaborative research group
C32 Examine the influences of social and political structures and realities that contribute to inquiry about scientific issues
C33 Use technology (e.g., desktop publishing, teleconferencing, networking) to communicate scientific ideas
C34 Explore and analyze a variety of perspectives on science (e.g., works by men and women of many racial, ethnic, and cultural groups)
C35 Lead groups of learners of various ages in designing, planning, and conducting science activities
C36 Respect the scientific thinking of others and self
C37 Recognize and contrast different epistemologies
C38 Develop possible courses of action in response to scientific issues of local and global concern
C39 Determine the validity of research conclusions in relation to the design, performance, and results
C40 Develop multimedia presentations of group and individual research projects and investigations appropriate for a variety of audiences and forums
C41 Produce interesting and scientifically correct stories and present them using various modes of expression
C42 Reflect on the ideas and content found in own journal records
C43 Examine ambiguous results and formulate explanations
C44 Recognize and synthesize the contributions to scientific thought of individuals from many cultures
C45 Construct models and simulations of the component structures and functions of living and nonliving entities
C46 Lead multi-age groups in the examination of and planned resolution for scientific issues
C47 Recognize and choose members of research teams based upon the merit of their ideas and skills
C48 Construct a portfolio of products, documentation, and self-evaluations of own abilities, skills, and experiences
C49 Synthesize scientific information from a variety of sources
C50 Evaluate and prioritize scientific issues based upon risk-benefit analyses
C51 Refine scientific skills from a variety of experiences

Subunit: Applications for Science Learning

Competencies:

A1 Answer student-determined questions by designing databases and drawing inferences from the analyses of the information in these databases
A2 Make personal behavior decisions by interpreting information that has a scientific basis
A3 Propose courses of action that will validate and demonstrate personal understandings of scientific principles
A4 Guide other learners in their understanding of the interactions of technologies and society at various periods in time
A5 Promote and carry out practices that contribute to a sustainable environment

A6 Study and propose improvements in public services and systems in own community
A7 Choose consumer materials utilizing personal and environmental risk and benefit information
A8 Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A9 Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
A10 Construct devices that perform simple, repetitive actions
A11 Investigate the functionality of various geometric shapes in the natural world and the designed world (e.g., translations from spherical to plane representations cause distortions; triangular shapes contribute to rigidity and stability in structures; round shapes minimize boundary for a given capacity)
A12 Make decisions regarding personal and public health
A13 Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A14 Analyze the contributions of advances in technology through history to own everyday life
A15 Identify and reduce risks and threats to a sustainable environment
A16 Extend the limits of human capabilities using technological enhancements
A17 Use and recognize various propaganda techniques
A18 Solve unique problems using the results of systematic analyses
A19 Choose everyday consumer products that utilize recent innovation and pass appropriate performance criteria
A20 Refine personal career interests through investigations of the diversity of manufacturing, research, service, and invention processes
A21 Predict and investigate the working of toys and tools while controlling and manipulating variables (e.g., friction, gravity, forces)
A22 Write, follow, modify, and extend instructions (e.g., equations, algorithms, formulas, flow diagrams, illustrations)
A23 Create products, make inferences, and draw conclusions using databases, spreadsheets, and other technologies
A24 Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
A25 Use scientific evidence to consider options and formulate positions about the health and safety of others and self
A26 Search for, use, create, and store objects and information using various strategies and methods of organization and access
A27 Research and write environmental impact statements of own design
A28 Compare school-based science perspectives with those gained through cutting-edge technological applications
A29 Design management plans for natural and human-altered environments (e.g., woodlots, patios, lots, lawns, farmlands, forests)
A30 Refine personal career interests
A31 Promote public awareness of the interaction of technology with social issues
A32 Advocate and propose courses of action for local and global scientific issues using global networks
A33 Use appropriate technologies to prepare and present the findings of investigations incorporating tables, graphs, diagrams, and text
A34 Make informed consumer choices by evaluating and prioritizing information, evidence, and strategies
A35 Develop an informed point of view that allows for validation or refutation of the scientific statements and claims of advocates before pursuing courses of action (e.g., contributing support, signing petitions, casting votes)
A36 Differentiate between observations and inferences in the exploration of evidence related to personal, scientific, and community issues
A37 Develop and write environmental impact, and safety and hygiene management plans
A38 Use technology to collect, analyze, and communicate information (e.g., electronic networks, desktop publishing, remote sensing, graphing calculators, satellite telemetry, and others)
A39 Design, construct, and market inventions

Academic Competencies: Environmental Management

The Environmental Management OCAP panel of expert workers (see member list on the inside back cover) identified the following academic competencies (from the total list, pp. 52-66) as most crucial to the entry-level success of an employee in the area of environmental management. It is recommended that these competencies be taught in an applied manner for students enrolled in environmental management programs.

Unit: Communications Skills

Subunit: Reading—Structure

Competencies:

RS1	Exhibit knowledge of language structure
RS2	Recognize that there may be more than one interpretation of reading selections
RS3	Recognize various literary devices
RS5	Develop and use an increasingly sophisticated vocabulary gained through context
RS6	Apply knowledge of language structure to reading
RS7	Explain why there may be more than one interpretation of reading selections
RS10	Recognize relationship of structure to meaning
RS11	Describe various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS14	Critique a variety of literature with regard to plot, dialogue, theme, setting, and characterization
RS15	Apply an expanding vocabulary gained through reading

Subunit: Reading—Meaning Construction

Competencies:

RM1	Demonstrate ability to recognize appropriate pre-reading strategies
RM2	Describe effectiveness of a reading selection
RM3	Read to clarify personal thinking and knowledge
RM4	Support interpretation of text by locating and citing specific information
RM7	Engage in self-selected reading activities
RM8	Confirm and extend meaning in reading by researching new concepts and facts
RM9	Self-monitor and apply corrective strategies when communication has been interrupted or lost
RM11	Assess effectiveness of a selection read
RM12	Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
RM16	Assess validity and quality of selection read (e.g., predict, summarize, analyze, infer)
RM17	Clarify meaning when reading, using knowledge of literary devices, stylistic diction, and other semantic elements
RM20	Use reference books to find, evaluate, and synthesize information

Subunit: Reading—Application

Competencies:

RA1	Select and read material for personal enjoyment and information
RA5	Develop and apply knowledge of the interrelationship of concepts (e.g., construction of webs, graphs, timelines)
RA7	Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities

Subunit: Reading—Multidisciplinary

Competencies:

RM2	Read to facilitate learning across curriculum
RM3	Read to develop awareness of human rights and freedom
RM4	Participate actively in a community of learners
RM9	Read to facilitate content learning

Subunit: Writing—Structure

Competencies:

WS1	Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through practice and discussion
WS2	Clarify word choice according to audience, topic, and purpose
WS3	Locate and correct errors in usage, spelling, and mechanics (e.g., subject-verb agreement, parallel construction, pronoun reference, punctuation, capitalization, sentence structure) using a variety of resources
WS4	Recognize information gained from primary and secondary sources
WS5	Develop writing that contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS6	Use information from a variety of sources to develop an integrated piece of writing
WS8	Recognize differences between documentation and reference list styles
WS9	Develop extended pieces of writing that contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS13	Appropriately cite information gained from primary and secondary sources
WS14	Use style manuals or software to prepare documentation and reference lists
WS15	Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas

Subunit: Writing—Meaning Construction

Competencies:

WM3	Respond to others' suggested revisions to a piece of writing (e.g., self-question, re-read, revise)
WM4	Use word processing, graphics, and publishing as aids for constructing meaning in writing
WM5	Engage in self-initiated writing activities
WM10	Recognize and refine personal writing styles

Subunit: Writing—Application

Competencies:

WA1	Apply appropriate writing techniques (e.g., prewriting, drafting, revising, editing, presenting) suitable for varied writing tasks
WA2	Use sentence-combining techniques to improve syntactic fluency and maturity
WA5	Consider audience and purpose for writing
WA8	Apply an expanding vocabulary gained through writing
WA9	Make judicious use of reference sources (e.g., dictionary, thesaurus, online database, encyclopedia)
WA11	Apply revising and editing strategies needed for writing task
WA18	Revise and edit papers extensively in preparation for presentation/publication
WA21	Develop topic fully and appropriately

Subunit: Writing—Multidisciplinary

Competencies:

WM1	Use writing process for learning across curriculum
WM4	Write in response to reading, speaking, viewing, and listening
WM8	Use communication processes to develop a published writing piece in collaboration with others
WM11	Write collaboratively with peers
WM12	Use cross-disciplinary resources in writing projects

Subunit: Listening/Visual Literacy—Structure

Competencies:

LS1	Listen to and view a wide variety of genres (e.g., mystery, drama, poetry)
LS3	Recognize correct and appropriate grammar, diction, and syntax
LS4	Expand vocabulary through listening to and viewing varied media (e.g., recordings, films, music, news broadcasts)
LS7	Recognize use and misuse of language in media
LS9	Expand and refine grammar, diction, and syntax through listening
LS11	Expand knowledge of complex grammar, diction, and syntax issues

Subunit: Listening/Visual Literacy—Meaning Construction

Competencies:

LM1	Develop critical thinking skills necessary to evaluate media and assess oral presentations
LM5	Gather information from listening and viewing experiences to enhance research
LM6	Use critical thinking skills to evaluate media and oral presentations
LM10	Use information gathered from listening and viewing experiences to expand research
LM12	Consider prior knowledge and experiences when attempting to understand the meaning of new texts
LM14	Select viewing and listening materials to support written text
LM17	Organize and use viewing and listening materials to support written text

Subunit: Listening/Visual Literacy—Application

Competencies:

LA1	Listen attentively during oral reading
LA2	Use media as stimuli for learning and thinking
LA6	Use technology and other media (e.g., videos, posters, maps, graphs, t-shirts) as means of expressing ideas

Subunit: Listening/Visual Literacy—Multidisciplinary

Competencies:

LM1	Facilitate learning across curriculum through critical listening and viewing
LM2	Engage in individual, small-group, and whole-group listening and viewing activities
LM5	Participate in a community of learners through productive listening

Subunit: Oral Communication—Structure

Competencies:

OS1	Refine oral communication skills (e.g., voice modulation, eye contact, body language)
OS2	Demonstrate knowledge of grammar, usage, and syntax when presenting
OS3	Select topics and vocabulary suitable to audience
OS4	Organize notes and ideas for speaking (e.g., cause-effect, chronological, exemplification)
OS5	Use language imaginatively (e.g., word games, puns, limericks)
OS7	Organize notes and ideas for formal, semiformal, and informal presentations of information
OS8	Refine speaking techniques for formal, semiformal, and informal settings
OS9	Develop repertoire of organizational strategies for presenting information orally
OS10	Expand vocabulary to fit topic
OS11	Select topics suitable to audience, situation, and purpose
OS12	Select appropriate strategies when organizing notes and ideas for speaking

Subunit: Oral Communications—Meaning Construction

Competencies:

OM1	Make connections between prior knowledge and new information for oral presentations
OM2	Participate in informal speaking activities (e.g., offering opinions, supporting statements, questions, clarification, entertainment)
OM3	Use interviewing techniques to gather information
OM5	Participate in group communication activities (e.g., debates, panel discussions, negotiations, book-sharing, roundtables, cooperative/collaborative groups)
OM6	Take and organize notes when preparing speech/presentation
OM9	Gather and assess information for speaking
OM10	Communicate orally to inform and persuade
OM11	Prepare and deliver formal speech/presentation
OM13	Assess needs of audience, and adjust language and presentation according to their knowledge
OM17	Analyze and synthesize information gathered from a variety of sources (e.g., interviews, hypermedia, reference works) for speaking

Subunit: Oral Communication—Application

Competencies:

OA1	Become proficient at using interviewing techniques
OA2	Give an oral interpretation for a specific audience
OA3	Develop and apply oral communication skills for cooperative/collaborative learning
OA4	Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
OA5	Develop and apply decision-making strategies
OA6	Practice interviewing techniques

Subunit: Oral Communications—Multidisciplinary

Competencies:

OM1	Value thinking and language of others
OM3	Be involved in individual, small-group, and whole-group language activities
OM4	Participate actively in a community of learners
OM5	Investigate language and cultural differences through oral language activities

Unit: Mathematics Skills

Subunit: Numbers and Number Relations

Competencies:

NR1	Compare, order, and determine equivalence of real numbers
NR2	Estimate answers, compute, and solve problems involving real numbers
NR3	Compare and contrast real number system, rational number system, and whole number system
NR4	Extend knowledge to complex number system, and develop facility with its operation

Subunit: Measurement

Competencies:

M1	Estimate and use measurements
M2	Understand the need for measurement and the probability that any measurement is accurate to some designated specification
M3	Understand and apply measurements related to power and work
M4	Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
M5	Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
M6	Use real-world problem situations involving mass and weight
M8	Establish ratios with and without common units
M9	Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics
M10	Understand and solve rate-change problems
M11	Understand and solve right triangle relationships as they relate to measurement—specifically those that deal with the Pythagorean theorem
M12	Graph and interpret ordered pairs
M13	Compute total sales from a variety of items
M14	Comprehend and compute rates of growth or decay
M16	Develop an ability to identify real problems and provide possible solutions
M17	Express and apply different types of measurement scales
M18	Determine area and volume

Subunit: Estimation and Mental Computation

Competencies:

E1	Use estimation to eliminate choices in multiple-choice tests
E2	Use estimation to determine reasonableness of problem situations in a wide variety of applications
E3	Estimate shape of graphs of various functions and algebraic expressions
E4	Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability

Competencies:

D1	Organize data into tables, charts, and graphs
D3	Use curve fitting to predict from data
D7	Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions
D9	Use sampling and recognize its role in statistical claims
D10	Design a statistical experiment to study problem, conduct experiment, and interpret and communicate outcomes
D11	Describe normal curve in general terms, and use its properties

Subunit: Algebra

Competencies:

A1	Describe problem situations by using and relating numerical, symbolic, and graphical representations
A2	Use language and notation of functions in symbolic and graphing settings
A3	Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solution of an equation in terms of graphical and symbolic representations
A5	Develop graphical techniques of solution for problem situations involving functions
A9	Determine slope, midpoint, and distance
A12	Solve quadratic equations by factoring and formula
A13	Set up and solve linear equations
A14	Solve systems of linear equations with two variables
A16	Describe measures of central tendency, mean, median, mode, and variance algebraically and graphically
A21	Graph linear functions
A28	Analyze and describe errors (and their sources) that can be made when using computers and calculators to solve problems
A37	Simplify algebraic expressions
A38	Use laws and exponents (including scientific notation)

Subunit: Geometry

Competencies:

G1	Create and interpret drawings of three-dimensional objects
G4	Demonstrate knowledge of angles and parallel and perpendicular lines
G9	Use deductive reasoning
G10	Explore compass and straightedge constructions in context of geometric theorems

Unit: Science Skills

Subunit: Scientific Inquiry

Competencies:

Q1	Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2	Use ratios, proportions, and probabilities in appropriate problem situations
Q3	Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q7	Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
Q8	Design investigations that are safe and ethical (i.e., obtain consent and inform others of potential outcomes, risks, and benefits; and show evidence of concern for the health and safety of humans and nonhuman species)
Q9	Make and read scale drawings, maps, models, and other representations to aid planning and understanding
Q11	Use appropriate units for counts and measures
Q12	Create and use databases (electronic and other) to collect, organize, and verify data and observations
Q14	Communicate the results of investigations clearly in a variety of situations
Q15	Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations
Q18	Observe and document events and characteristics of complex systems
Q20	Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques
Q22	Document potentially hazardous conditions and associated risks in selected homes and public areas
Q24	Construct and test models of physical, biological, social, and geological systems
Q27	Conduct theory-based research using surveys, observational instruments, and other methods
Q34	Create, standardize, and document procedures
Q37	Recognize and utilize classification systems for particles, elements, compounds, phenomena, organisms, and others for exploring and predicting properties and behaviors
Q39	Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing
Q40	Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories

Subunit: Scientific Knowledge

Competencies:

K1	Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
K2	Investigate the relationship between the rates of energy exchange and the relative energy level of components within systems (e.g., trophic levels of ecosystems, osmosis, rate of heating and cooling, storms)
K5	Investigate degrees of kinship among organisms and groups of organisms
K7	Investigate estimates and measurements of a wide range of distances and rates of change
K9	Investigate physical and chemical changes in living and nonliving systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
K10	Investigate simulations of nuclear change (e.g., radioactivity, half life, carbon dating)
K11	Investigate conservation principles associated with physical, chemical, and nuclear changes
K13	Formulate models and hypotheses for patterns in the natural world (e.g., earth structures, transportation systems, migrations, communications, constellations)
K16	Formulate and interpret explanations for the magnitudes of diversity at different periods of geologic time (e.g., mutation, global cataclysms, continental drift, competition, mass extinctions)
K18	Formulate understandings of geologic time (e.g., millennia, periods, epochs)
K20	Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration)

Subunit: Conditions for Learning Science

Competencies:

C1	Participate actively in dialogue about and resolution of community issues
C4	Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error
C8	Consider the scientific thinking and language of others
C13	Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications
C23	Seek information on topics of personal scientific interest from a variety of sources
C27	Perform investigations that require observations over varying periods of time
C29	Access appropriate technology to perform complicated, time-consuming tasks
C31	Work as a contributing member of a collaborative research group
C36	Respect the scientific thinking of others and self
C51	Refine scientific skills from a variety of experiences

Subunit: Applications for Science Learning

Competencies:

A3	Propose courses of action that will validate and demonstrate personal understandings of scientific principles
A5	Promote and carry out practices that contribute to a sustainable environment
A6	Study and propose improvements in public services and systems in own community
A7	Choose consumer materials utilizing personal and environmental risk and benefit information
A8	Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A12	Make decisions regarding personal and public health
A13	Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A15	Identify and reduce risks and threats to a sustainable environment
A24	Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
A25	Use scientific evidence to consider options and formulate positions about the health and safety of others and self
A27	Research and write environmental impact statements of own design
A28	Compare school-based science perspectives with those gained through cutting-edge technological applications
A30	Refine personal career interests
A34	Make informed consumer choices by evaluating and prioritizing information, evidence, and strategies
A37	Develop and write environmental impact, and safety and hygiene management plans
A38	Use technology to collect, analyze, and communicate information (e.g., electronic networks, desktop publishing, remote sensing, graphing calculators, satellite telemetry, and others)

Verification Panels

The Vocational Instructional Materials Laboratory wishes to extend thanks and appreciation to the many representatives of business, industry, labor, and community organizations who donated their time and expertise to the identification and revalidation of competencies.

The following panel was responsible for verifying the occupational competencies on the Environmental Management OCAP, identifying those academic competencies that an entry-level employee should possess, and determining the Work Keys academic skill levels required for successful entry into the occupation:

Tammy L. Clements, *City of Dayton*, Dayton, Ohio
Larry Dickerson, *Ohio EPA*, Dayton, Ohio
Tom Filbert, *Department of Natural Resources*, Columbus, Ohio
Richard L. Scott, *Procter & Gamble Manufacturing Co.*, Lima, Ohio
Gary Sheely, *City of Lima*, Lima, Ohio
Jim Shoemaker, *City of Dayton*, Dayton, Ohio
George Skidmore, *Montgomery Soil & Water Conservation District*, Trotwood, Ohio
Matt B. Tin, *R. D. Zande & Associates, Inc.*, Columbus, Ohio
Daniel L. Young, *Environmental Professional & Technical Services*, Cincinnati, Ohio

The following panel was responsible for verifying the competencies on the Employability OCAP:

Barbara J. Forster, *Nationwide Insurance*, Columbus, Ohio
Joan L. Hall, *Health Management Nursing*, Chesapeake, Ohio
Jane Highland, *Southern Ohio Staffing, inc.*, Chillicothe, Ohio
Chuck Jackson, *Butech, Inc.*, Salem, Ohio
Garry Kessel, *Medina Auto Parts, Inc.*, Medina, Ohio
Joyce A. McMickens, *Ernst & Young*, Cleveland, Ohio
Julie C. Payeff, *The Andersons Management Corp.*, Maumee, Ohio
Patricia Piper, *Edison Industrial Systems Center*, Toledo, Ohio
Gary F. Rybak, *Red Roof Inns, Inc.*, Hilliard, Ohio